October 1, 1956 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Why Bell Chose Triple Turbine

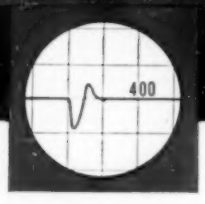
•

Aero 680 Displays High Performance

Aero Commander 680

First in Constant Speed Drives...

SUNDSTRAND



DC-8 advanced electrical system design made possible by Sundstrand Constant Speed Drives

Douglas engineers are going all out to make the DC-8 the best jet airliner modern technology can produce. They have incorporated advanced thinking in the electrical system design—a constant frequency Sundstrand-driven system that is automatic, paralleled, able to supply plenty of stable power under all flight conditions, and having heavy overload capacity. Necessary capacity is gained with less weight, easier utilization, assured reliability, and low cost of operation. The DC-8 will prove again how advanced design in electrical systems . . . made possible by the Sundstrand Constant Speed Drive . . . meets the challenge of today's . . . and tomorrow's . . . fast, high-flying jets.

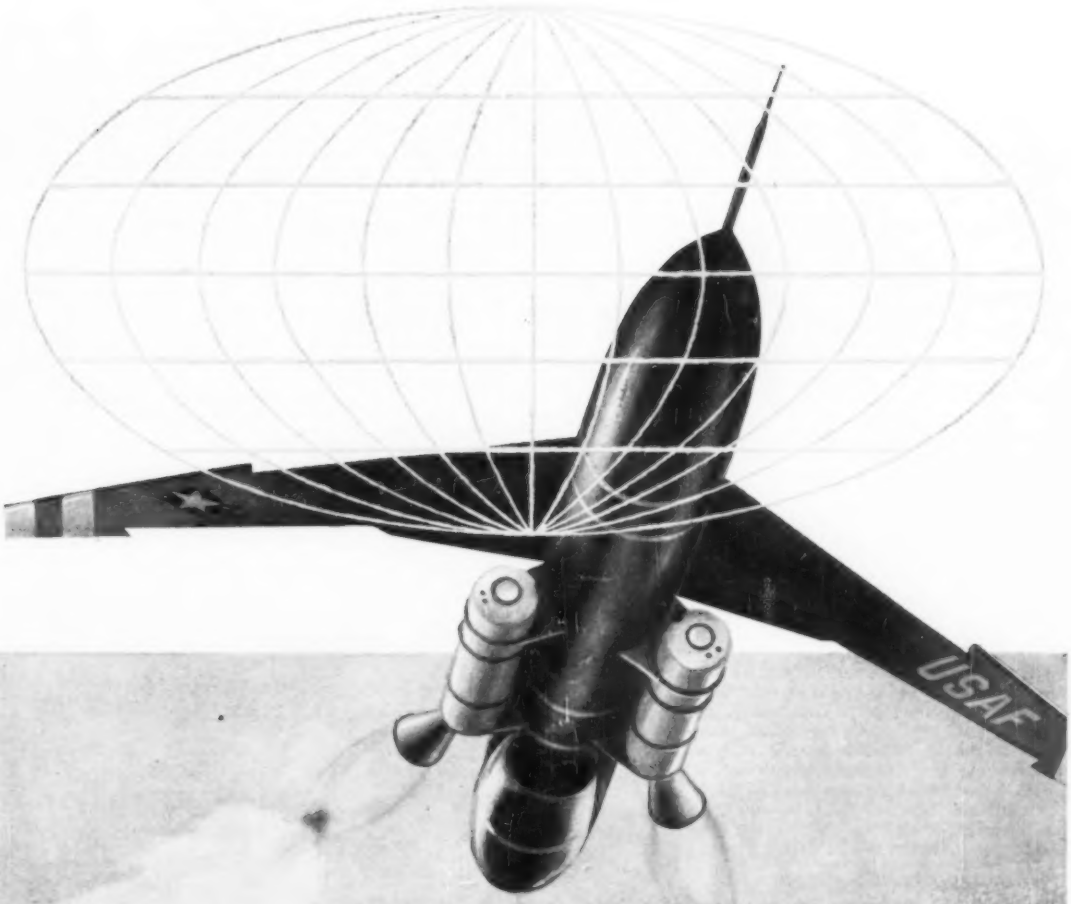
New Electrical Horizons . . .

are opening to design engineers, through co-operation between engine and airframe manufacturers and Sundstrand. With this advanced design in electrical systems, expect remarkable advances in operation and performance of tomorrow's aircraft.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, ROCKFORD, ILLINOIS Western District Office: Hawthorne, California

CONSTANT SPEED DRIVES · AIRCRAFT ACCESSORIES



Who puts the "Soup" to the Snark?

Special Cells Engineered by Goodyear Stow Fuel for the Snark's Intercontinental Range

New propellants used by today's—and the future's—missiles and pilotless bombers pose awesome problems.

While we cannot discuss these problems in public print, we can point with pride to accomplishments of Goodyear's Aviation Products Division which has solved touchy fuel handling problems.

A good case in point is Northrop's sixty-seven-foot Snark, the only U. S. guided missile which can match the striking radius of strategic jet bombers.

Other examples in the same category include special Goodyear advancements which have made it possible to stow and safely utilize new monopropellants—and to safeguard dangerous fuel- and oxidizer-systems against premature detonation.

If you are working with new fuels, it will pay you dividends to call on the facilities, skills and experience of Goodyear Aviation Products. We have found new materials and methods for taming the new "flighty" propellants and have produced fuel cells, diaphragms and expeller bags of standout success *in action* against corrosion, oxygen and temperature extremes.

Call on the Goodyear Fuel Cell Engineer for information. Complete details available to properly cleared personnel. Write: Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

GOODYEAR AVIATION PRODUCTS

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

Design, Development, Production

CASE HISTORIES

of Weber Aircraft Corporation

subject: **BUFFET FOR C-121C**

Weber Aircraft Corporation, 2820 Ontario Street, Burbank, California

NEW WEBER BUFFET PROVIDES HOT MEALS FOR MATS PASSENGERS ON C-121C

Military personnel being flown on long hops throughout the world by the Military Air Transport Service will enjoy hot, nourishing meals on Lockheed's new C-121C.

One of the fastest military transports in service, the new triple-duty Lockheed Super Constellation uses the Weber buffet on long trips. This new C-121C can be quickly converted from a 75-passenger version to either a flying ambulance carrying 47 litter patients plus hospital attendants or to an aerial packhorse toting more than 14 tons of bulk cargo.

Powered by four turbo-compound engines, the C-121C has a maximum take-off weight of 133,000 pounds and is 116½ feet long. It cruises at 335 m.p.h. The Weber buffet was designed for such convertible ships as this. It can quickly be installed or removed to meet the specific requirements of the flight.

This triple-duty Super Constellation can be quick-switched to cargo, passenger, or hospital litter duty. The Weber Buffet and seats are easy to install or remove.

A WAF Airman 1st Class and a Staff Sergeant prepare to serve a test group from the new Weber Buffet. Plant test demonstrations under typical operating conditions were held during the development of the Buffet and Passenger seats to assure maximum convenience and utility.

Serves up to 80 with hot meals

Up to 80 passengers can be served hot delicious dinners from the new Weber buffet which has just been developed by Weber in conjunction with MATS, WADC, AMC and Lockheed personnel. This new buffet is equipped with frozen food ovens that quickly convert frozen meals to hot ones. Variety is provided by a series of 10 different menus. A typical serving includes: roast turkey with dressing, mashed potatoes, lima beans, salad, ice cream and a beverage.

Complete kitchen facilities

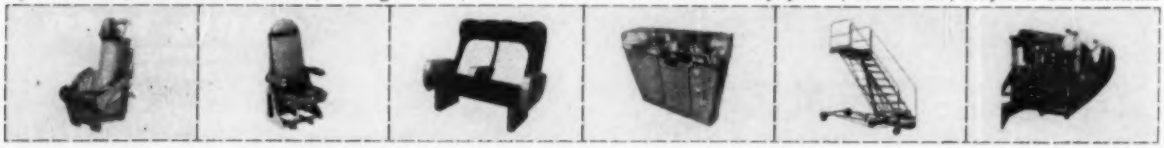
In addition to the ovens, the buffet has a dry ice refrigerator, hot and cold liquid containers, hot cups, individual serving trays, a portable water system, a sink, complete electrical system, refuse container and miscellaneous storage space. The buffet is readily removable and is adaptable to many types of military air transports. All working and exposed surfaces are stainless steel with the frame construction of aluminum.

Specially designed passenger seats

The Weber passenger seats used in conjunction with the buffet are also removable. Plenty of passenger comfort is offered, yet the seats may be folded against the bulkhead or placed in cargo compartments. Separate serving trays are provided with each seat, as well as space for an exposure suit and a Mae West life jacket. Real comfort for passengers is assured with contoured foam rubber construction covered with nylon plus the fact that each seat can be individually reclined.

During development of the buffet and seats, WAF personnel served a series of meals under typical operating conditions. On the basis of this testing, modifications were made to provide maximum efficiency and ease of operation. This is another example of Weber Aircraft Corporation solving problems of the aircraft industry from initial proposal thru final production.

Also Manufacturers of:
Ejection Seats / Pilot and Crew Seats / Passenger Seats / Wash Basins and Other Interior Equipment / Aerostands / Airframe Sub-assemblies



WEBER AIRCRAFT CORPORATION, 2820 ONTARIO STREET, BURBANK, CALIFORNIA

AVIATION CALENDAR

Oct. 1-3—12th Annual National Electronics Conference, sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, Illinois Institute of Technology and Illinois and Northwestern Universities, Hotel Sherman, Chicago, Ill.

Oct. 2—1956 Aircraft Spark Plug and Ignition Conference, Secor Hotel, Toledo, Ohio.

Oct. 2-6—Society of Automotive Engineers, National Aeronautic Meeting, Aircraft Production Forum and Engineering Display, Hotel Statler, Los Angeles, Calif.

Oct. 3-5—1956 National Airports Conference, Univ. of Oklahoma, Norman, Okla.

Oct. 4-6—Biennial Technical Conference, University of Minnesota, Rosemount Aeronautical Labs., Rosemount, Minn.

Oct. 8-9—Aeronautical Communications Symposium, Hotel Utica, Utica, N. Y.

Oct. 8-10—Third jointly sponsored annual Lubrication Conference of American Society of Mechanical Engineers-American Society of Lubrication Engineers, Chalfonte-Haddon Hall, Atlantic City, N. J.

Oct. 8-12—National Fall Meeting, American Welding Society, running concurrently with National Metals Exposition, Hotel Cleveland, Cleveland, Ohio.

Oct. 9-11—Second Joint Military-Industry Symposium on Packaging and Materials Handling, sponsored by USAF in cooperation with other services and Dept. of Commerce. Departmental and Dept. of Commerce auditoriums, Washington, D. C.

Oct. 11-12—Seventh Annual Noise Abatement Symposium, Hotel Sherman, Chicago, Ill.

Oct. 10-12—Society of Automotive Engineers, National Transportation Meeting, Hotel New Yorker, N. Y.

Oct. 10-12-16—National Advisory Committee for Aeronautics' triennial inspection of Langley Aeronautical Laboratory.

Oct. 15-19—Second Annual Worldwide Conference of USAF flying safety officers, conducted by USAF Flight Safety Research, Keesler AFB, Biloxi, Miss.

Oct. 25-26—Aircraft Electrical Society Annual Equipment Display, Pan Pacific Auditorium, Los Angeles, Calif.

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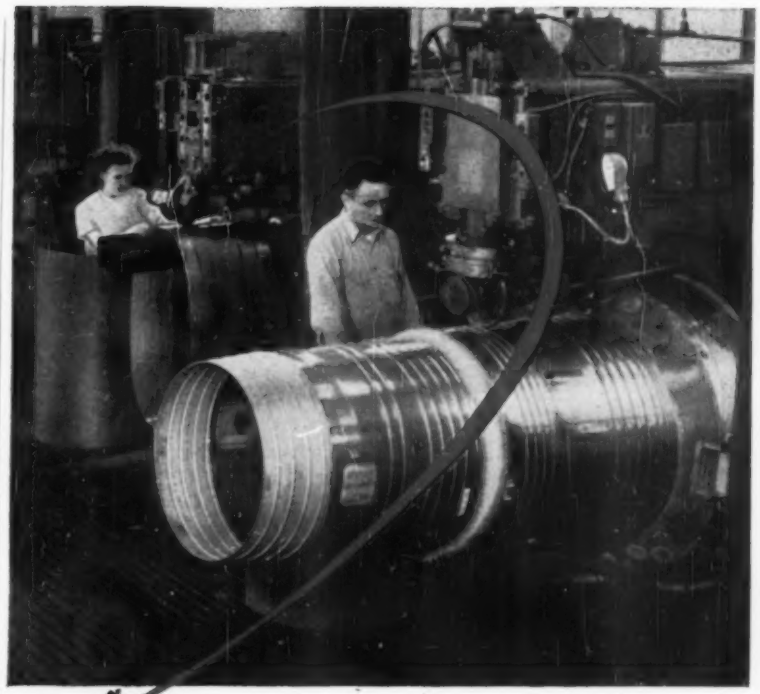

Men, Methods and Machines teamed for CONTROLLED WELDING at Lavelle

Experienced welding engineers and technicians use individualized and advanced methods with Government Certified equipment to produce specification weldments at Lavelle. This accurately *controlled* welding insures the Grumman engine shroud shown above against the stresses of high temperature jet engine speeds . . . where peak performance proves the advantages of this specialized Lavelle fabricating service.

Lavelle fabricates weldments of titanium, high temperature resistant nickel and steel alloys and aluminum . . . by resistance, automatic or manual inert gas, metallic arc, and oxy-acetylene welding. Weld quality is *controlled* by rigid inspection using X-Ray, Zyglo, Magnaflux and microscopic procedures.

Major manufacturers depend on Lavelle's *controlled* welding to meet exacting specifications . . . Lavelle's dependable delivery to meet demanding production schedules. When your production standards require the finest in specialized fabricating services . . . contact Lavelle.

This illustrated brochure gives additional data on Lavelle services. Write for a copy without obligation.

Lavelle

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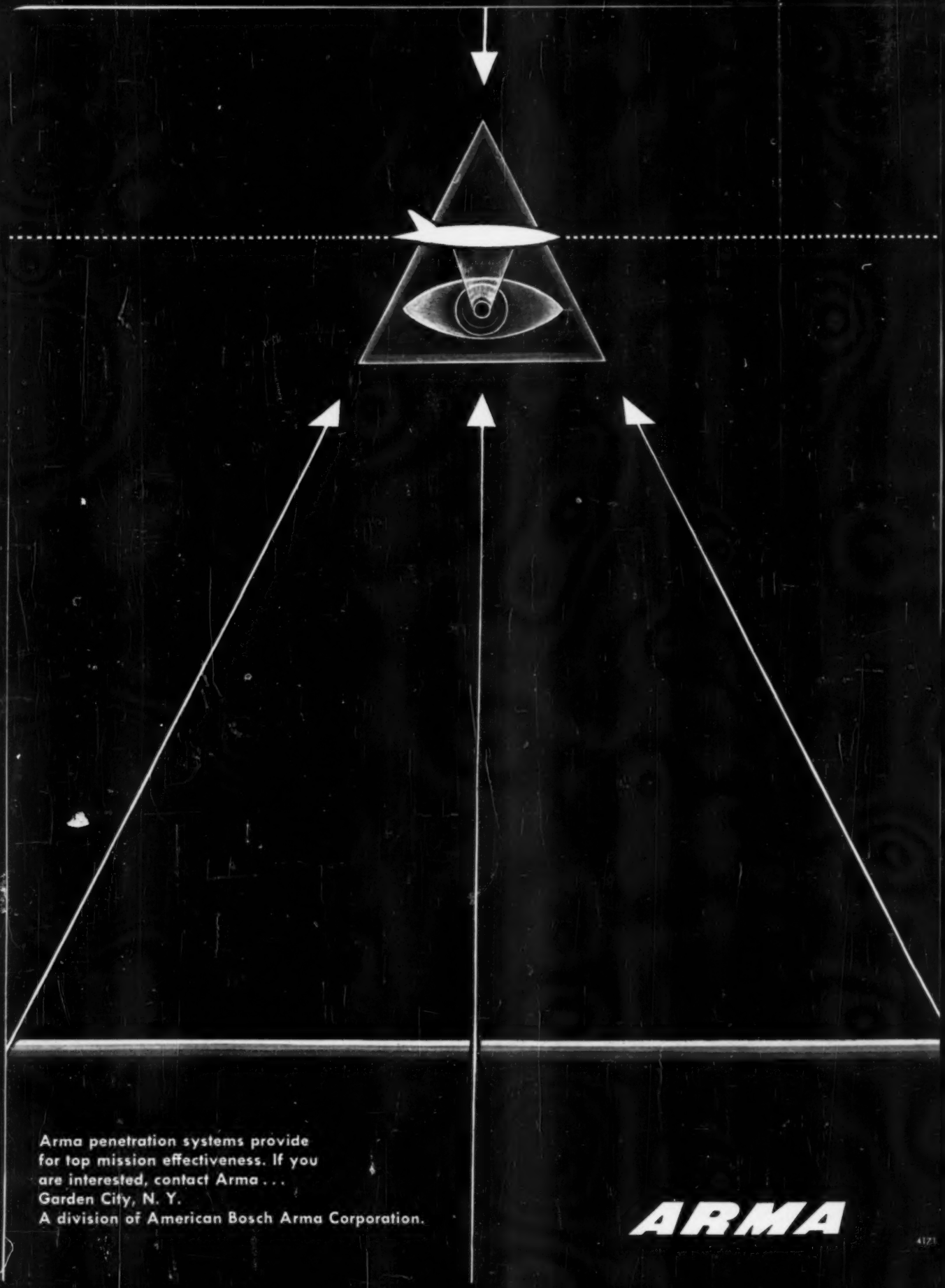

Arma penetration systems provide
for top mission effectiveness. If you
are interested, contact Arma . . .
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A division of American Bosch Arma Corporation.

ARMA

4121

A wink built for speed!

The speed of a wink varies, depending upon its purpose . . . and its target. The femme fatale's provocative wink from the dim recesses of a cocktail lounge may pack the wallop of a Sabre-Jet, yet its speed is a languorous one-tenth of a second. Imagine a wink five hundred time as fast! Fairchild Camera and Instrument Corp. has produced a camera that does just that. Its shutter speed is 1/5000th of a second . . . a speed made possible only by using Titanium shutter leaves. Such shutter speeds are essential in guided missile research and the development of supersonic devices.

Titanium had the necessary light weight, rigidity, fatigue resistance, corrosion resistance and capability of being rolled to a thickness of 0.0022" with a tolerance of ± 0.0001".

Just one of the many jobs being done better with Titanium.

TMCA is the world's major supplier of Titanium bar, billet, sheet, strip, wire, extrusions and tubing to jet engine, guided missile, atomic energy, chemical processing and marine industries.

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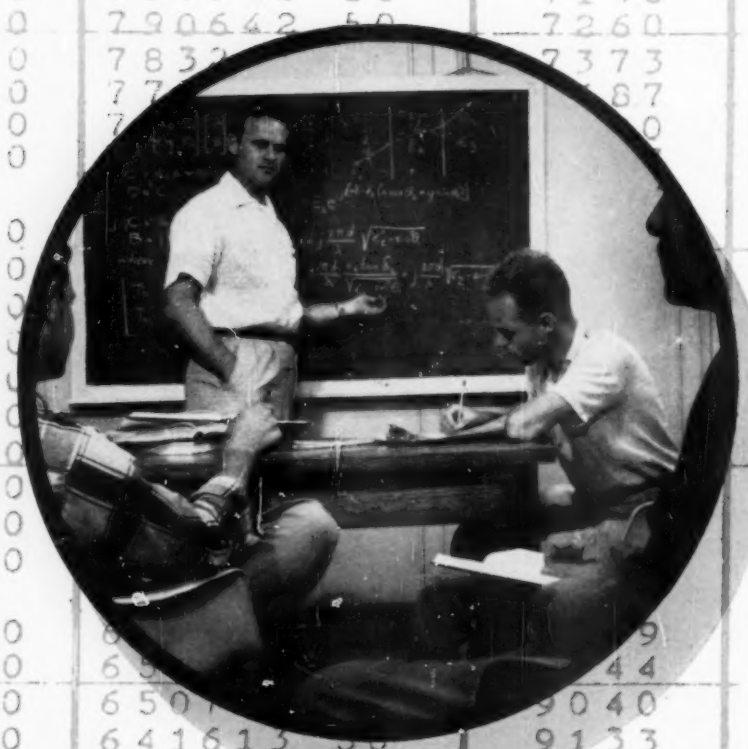
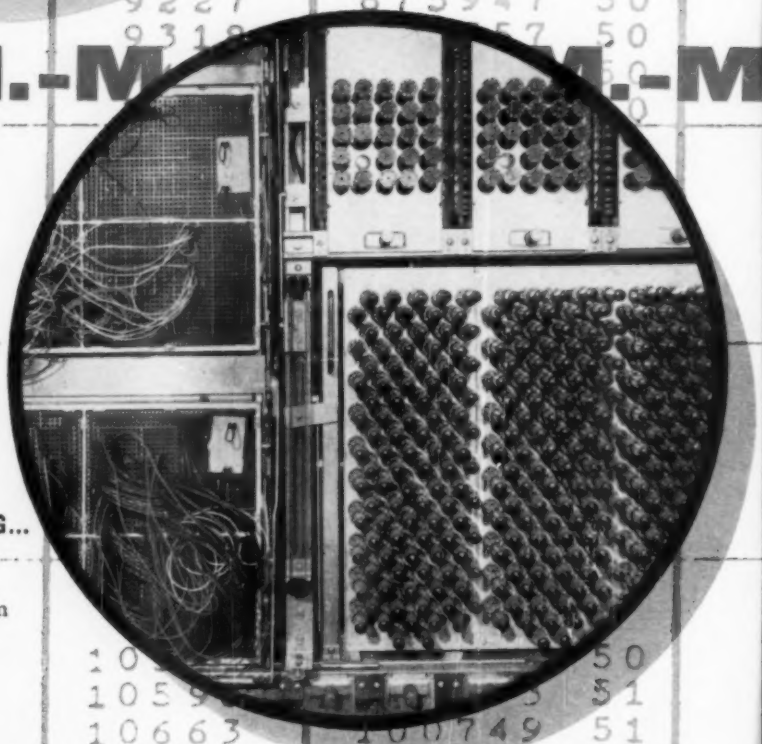


EXPERIENCE EQUIPMENT MECHANISMS AND MEN



E.-E.- M.-M

ZENITH HAS PRODUCED RADOMES FOR THE FOLLOWING...

B-29	F-3D	F-105	S2F
B 36	F-4V	C-119	Sea Venom
B 47	F-8V	C-124	T 33
B 50	F-80	C-130	T 36
B 52	F-84	P2V4	TF102
B 58	F-89	P2V2	WV-1
B 60	F-90	P2V3	WV-2
B 66	F-94	P2V4	The Snark and
F-2H	F-96	P2V5	other guided
F-2H1	F-101	P2V6	missiles
F-2H2	F-102	P2V7	
F-2H3	F-103	P5YM	
P2Y-1	F-104	R3Y	

And many others, both military and commercial, for U.S., Canada, France, Sweden, etc.

E.-E.-M.-M. E.-E.-M.-M.

This is the code for the combination that almost automatically refers radome problems today to the Aircraft Division of Zenith Plastics Company.

EXPERIENCE—in the highly specialized and sensitive radome field, beyond that available from any other source to the Armed Forces and the aircraft industry.

EQUIPMENT that is as complete as can be devised by human ingenuity, for producing and testing the ultimate in radomes for the last word in planes.

MECHANISMS so complete and amazing in their ability to surpass all human methods of computation, that the most abstruse mathematical problems literally seem to solve themselves.

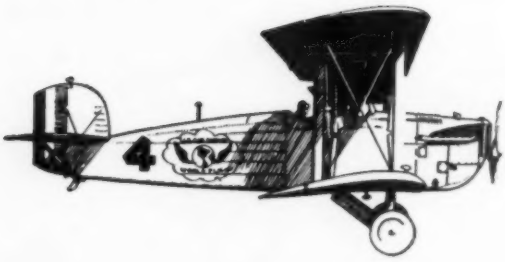
finally—MEN. First, a team of scientists and engineers who are probably the best schooled group in all the ramifications of radome theory and radome production that could be assembled anywhere today.

And second, over a thousand skilled workers and technicians who man the world's largest plant producing reinforced plastics for the aircraft industry.

In Research and Development in the radome field, Zenith has the facilities and manpower to *produce* when our country calls.

ZENITH PLASTICS CO., GARDENA, CALIFORNIA

Subsidiary of Minnesota Mining & Mfg. Co.

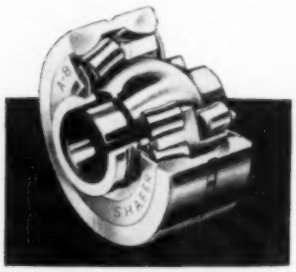


Thirty years ago a fleet of four of these Douglas World Cruisers circled the globe. Today's C-133A carries a fuel load alone of twice the weight of all four aircraft.

IN MODERN TRANSPORTS...

it takes a lot more today

The new Douglas C-133A is one of the world's fastest cargo carriers. Its 24,000 hp. and huge "drive-in" cargo space enable it to carry twice the load of anything in service today.



Double row shown. Also, single-row bearing, rod end and torque tube bearings. Design features 10° plus or minus self-alignment...easy relubrication without disassembly... high radial and thrust load capacity...exceptional shock-load reserve strength.

Bigger loads and higher speeds of today's transports take a lot more in bearing performance—and Shafer Aircraft Bearings are providing it for many of these modern planes.

The three main reasons for Shafer being specified in these designs are:

1) Integral self-alignment—*even under oscillatory loads.* Only Shafer offers this advantage that solves a severe problem in modern aircraft design.

2) Full capacity—*under combined loads.* Double-row bearings carry any radial-thrust combinations on full contact area under any misalignment.

3) Relubrication—*without disassembly.* Lubricating groove allows burying Shafer in any member provided with lubricating fitting—for easy relubricating.

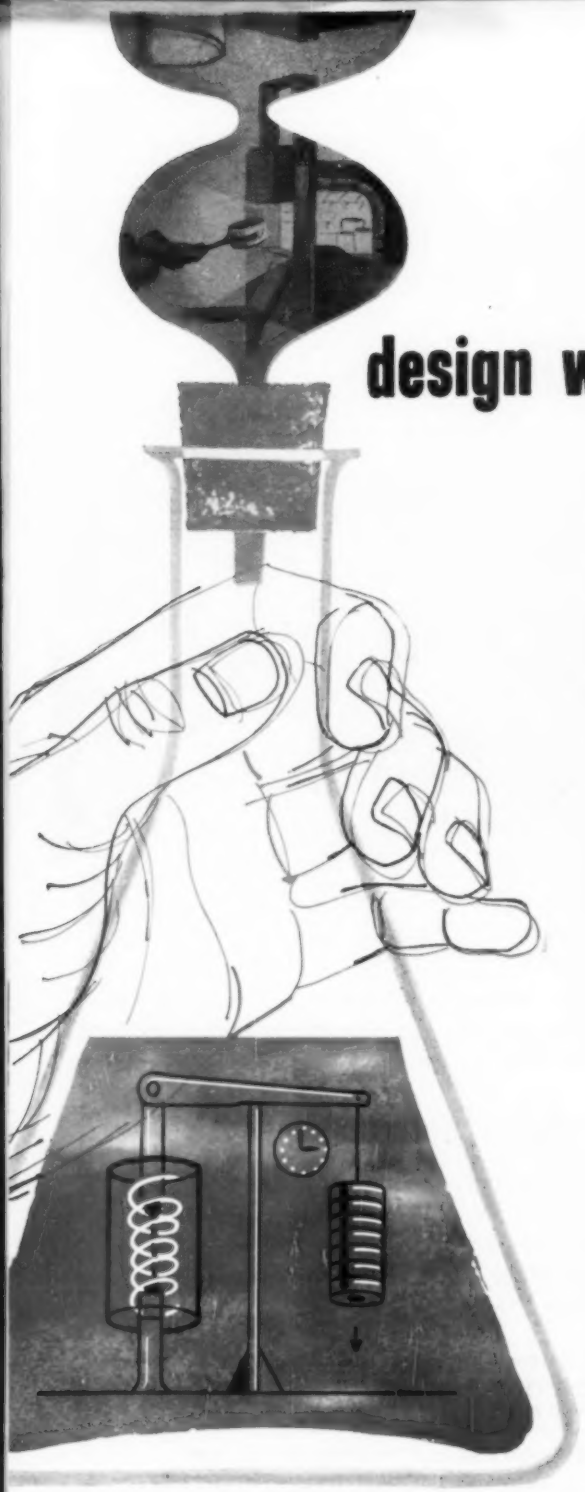
These and many other specialized Shafer Aircraft Bearing features can save valuable engineering time ...save space and weight in finalized design...and save time and expense in production man-hours.

Why not see how they can save for you?

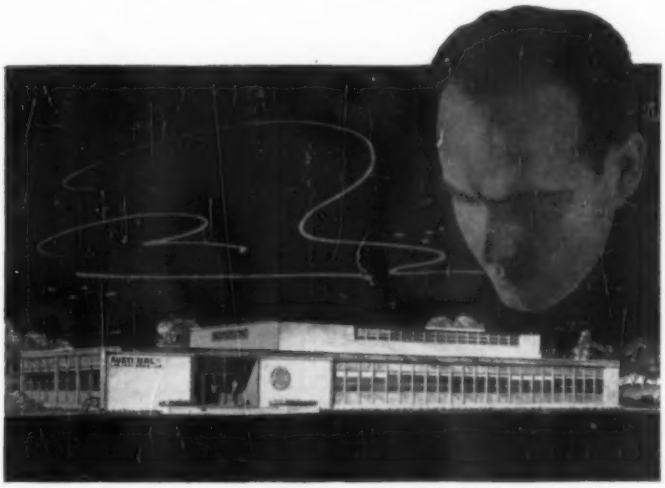
Write, wire or call: Shafer Aircraft Bearing Division, 801 Burlington Ave., Downers Grove, Ill. Meanwhile, write for new full-color catalog No. 54.

SHAFER BEARING DIVISION

CHAIN BELT COMPANY



design with austenal in mind



New **microcast** *Research Facilities will increase investment casting applications and give design engineers greater latitude in planning parts.*

A new facility for advanced research is now under construction at Austenal to broaden the many applications of Microcast—to make new methods and alloys available, and to allow greater freedom and latitude in part designing.

One section of this new plant will contain the equipment familiar to the investment casting industry and in addition, equipment necessary for investigating numerous other methods of making and treating castings. Adjoining the foundry area will be shops for pilot line and experimental work in mold making, waxing, investing and finishing. There will be an area containing laboratories for mechanical testing, physical testing, metallographic investigations, refractories development and chemical investigations.

Contact your Austenal engineer today and ask him to show you how Austenal's continuing program of research and development will help you design greater performance and reliability into the investment castings you require.

- - - It's **NEW** *from Austenal*

"Design with Microcast in Mind," Austenal's new informative booklet, tells you how to get the greatest benefit from Microcast, showing the great latitude of design possibilities, alloys available and a great deal more, valuable information. Write for it today.

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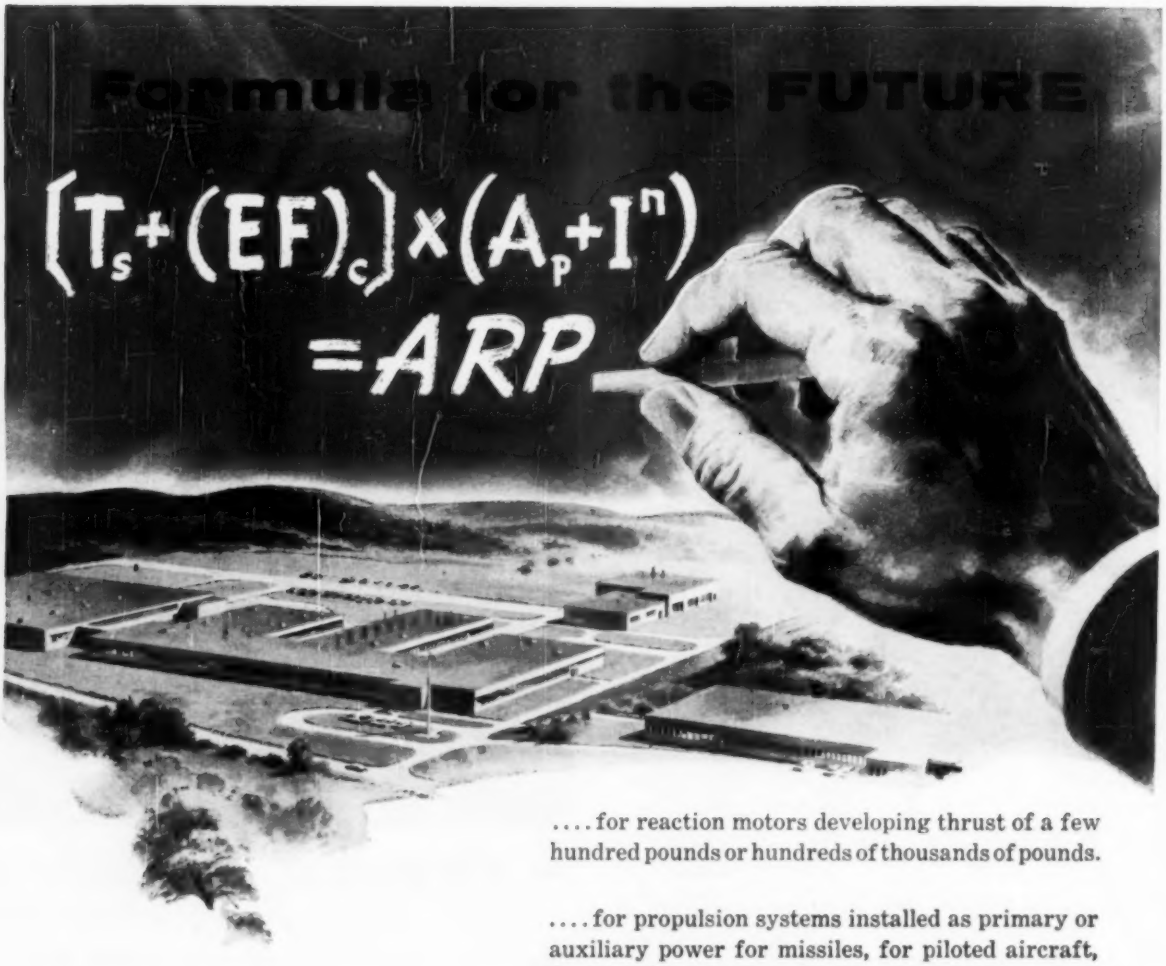

....for reaction motors developing thrust of a few hundred pounds or hundreds of thousands of pounds.

....for propulsion systems installed as primary or auxiliary power for missiles, for piloted aircraft, for launching devices.

...for unprecedented power in the many diversified applications where advanced rocket technology has heralded the beginning of a new era.

....for the future developments that will come from *RMI POWER ENGINEERING*—as they have for the past 14 years.

Rewarding career opportunities are available for experienced engineers, physicists, mathematicians and chemists. Send resume and salary requirements to Employment Manager.

PRIMARY AND AUXILIARY ROCKET POWER FOR:
Missile Boosters and Sustainers, Aircraft, Target Drones, Ordnance Rockets, Ejection Systems, Launching Devices.

*** KEY**

T_s .....skilled technicians

$(EF)_c$. complete equipment and facilities

A_p ....past accomplishment

I^n .....unlimited imagination

ARP . . advanced rocket power

Power for Progress

RMI

REACTION MOTORS, INC.

A MEMBER OF THE OMAR TEAM

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RYAN TO BUILD DC-8 JET PACKS AND PYLONS

Jet Packs. Ryan has been selected by the Douglas Aircraft Company to manufacture complete jet power packs and pylons for the new DC-8 commercial airliner. Substantial orders for these 550 mph Jetliners have been placed by 11 major airlines.

Broad Experience. The Douglas order, like Ryan's many other commercial and military contracts, is the result of an outstanding record of performance in the design and production of jet engine components, afterburners, rocket motors, ramjets and exhaust equipment for turbo-compound and piston engines.

Engineering. Ryan is devoting a substantial amount of effort to working with Douglas personnel in the engineering of the DC-8 jet packs and the supporting pylons. Ryan has extensive experience in the integration of power plants and airframe structures.

Established, Equipped. A pioneer in aircraft, Ryan understands the industry's requirements and fulfills them as only an aircraft company can. Ryan has the personnel and facilities to perform a complete job of engineering, production and evaluation of specialized structures such as jet packs and pylons.

With a background of 33 years of experience in aviation, Ryan excels in designing and producing high quality aircraft, power plants and avionics, built at low cost, delivered on time.

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HE SHALL HAVE
MOBILITY
WHEREVER HE GOES

Out where there are no runways, Vertol helicopters are strong links in the chain of Air Force logistical support.

The eyes of our Air Defense Command—the Early Warning radar outposts in the Far North and off our coasts—are tied to their supply centers by Vertol helicopters. Daily H-21 Workhorse helicopters shuttle personnel and tons of equipment to remote radar and communication stations; they have already played an indispensable part in the construction of these outposts.

Tactical Air Force combat teams depend on the rugged H-21's to fly them into action, to airlift reinforcements and supplies to them.

Airmen downed in remote areas, civilians hard hit by disaster . . . for these, the H-21's in the Air Rescue Service may mean safety, shelter—and survival.

Engineers, join Vertol's advanced engineering team!

VERTOL *Aircraft Corporation*

MORTON, PENNSYLVANIA

FORMERLY PIASECKI HELICOPTER CORPORATION

NEW! for Jet Aircraft

ULTRA LIGHT-WEIGHT MOUNTING SYSTEMS

ROBINSON

Flight-Weight

ALL-METAL SHOCK AND VIBRATION MOUNTS FOR ELECTRONIC EQUIPMENT

offering to aircraft designers a new line of mountings for specialized airborne installations requiring light weight plus unfailing protection against operational hazards to vital electronic controls.

Designers of advanced aircraft, by incorporating the new Robinson Flight-Weight mountings during design stages, will thereby save those vital pounds needed for maximum performance.

Robinson Flight-Weights are ***complete systems,*** engineered to guard against shock and vibration of all types, yet they take up less space, and weigh far less, than outmoded tray and isolator assemblies.

The reliability of electronic equipment is dependent to a great extent upon the protection provided against adverse vibration and shock environment. The prime purpose of these mounting systems, developed by Robinson, is to ***control and improve that environment*** most efficiently. By taking advantage of this technique, it is possible to prevent unnecessary redesign or ruggedization of equipment.

Weight-saving results when advantage is taken of equipment location in the aircraft. Equipment compartmentized between structural bulkheads and separated from flight personnel may be mounted on mountings which are designed in accordance with the structural design strength of the aircraft itself. The designer then can take advantage of the weight saving resulting from the reduction in the load factor from the 30 "G" shock requirement specification.

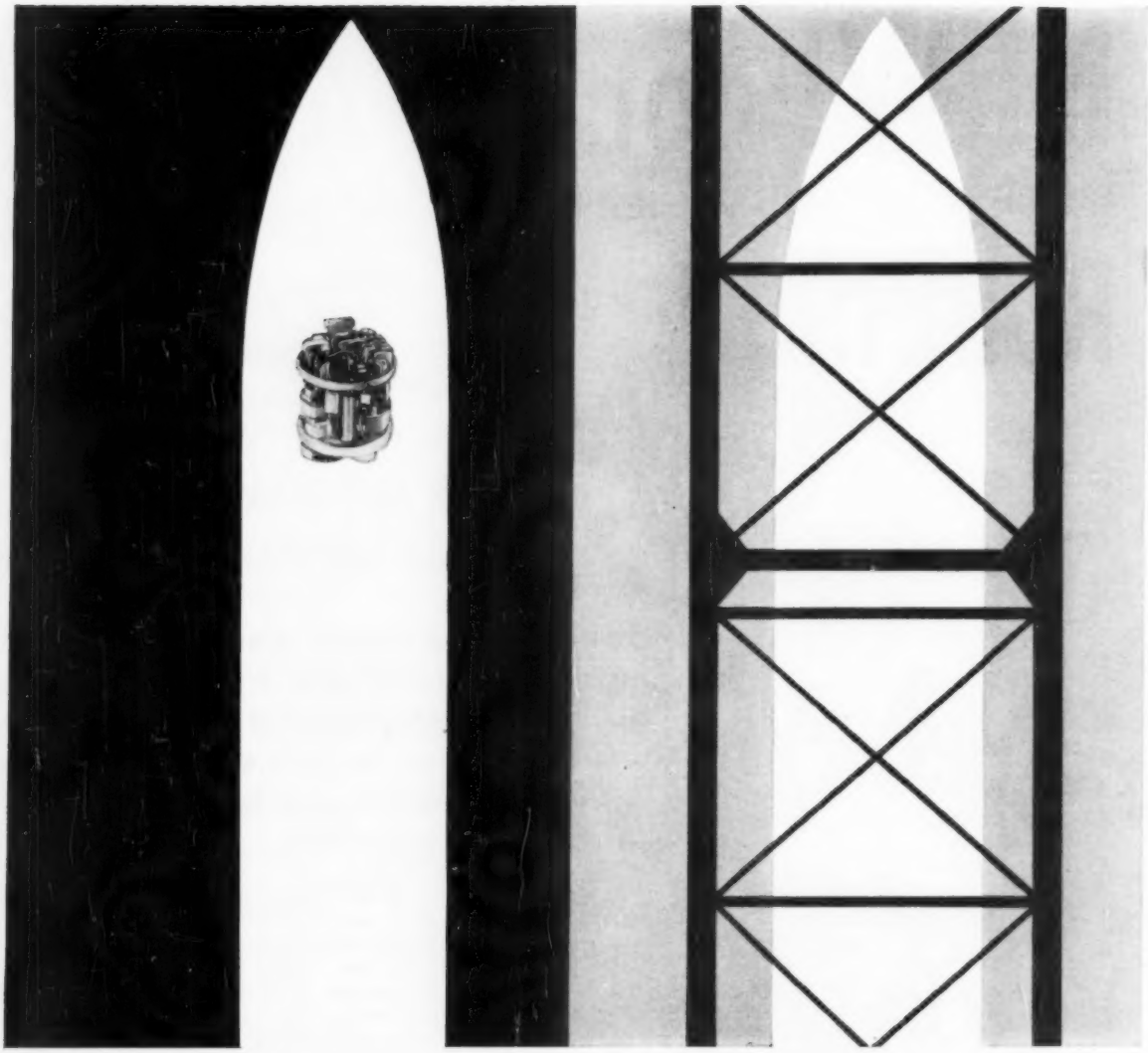
To designers confronted with the problem of combining light weight and the widest measure of protection, we offer unrivalled experience in this field. Robinson engineered systems, involving the exclusive Met-L-Flex fabricated wire resilient cushions, are widely used in first-line jet fighter and bomber aircraft.

Send for latest engineering information on these new Flight-Weight mounting systems.

VIBRATION CONTROL IS RELIABILITY CONTROL

ROBINSON AVIATION INC.
TETERBORO NEW JERSEY
Vibration Control Engineers
AIRBORNE DIVISION

WEST COAST ENGINEERING OFFICE: 3006 WILSHIRE BLVD., SANTA MONICA, CAL.



From sensitive components to brawny launchers . . .

AMF has missile experience you can use

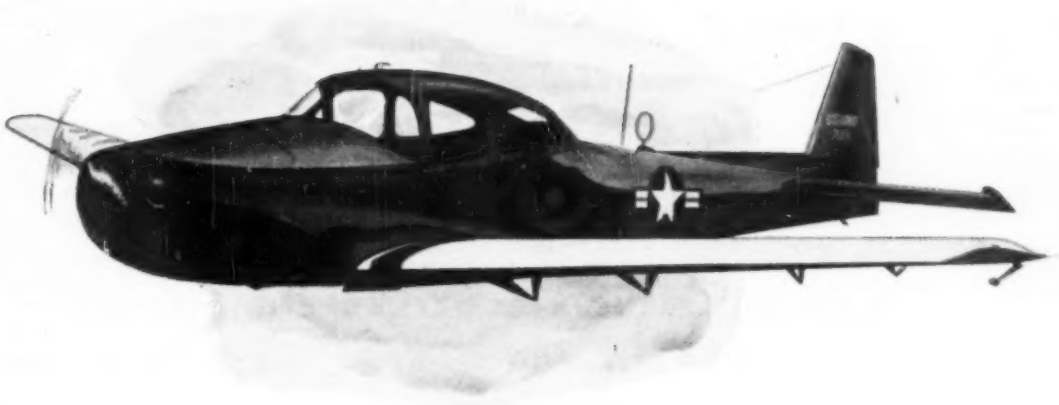
● "Precisioneering" power supplies for electronic control systems and developing complex launchers are two of AMF's *many* important contributions to our nation's missile programs ● Today, AMF plays a part in *more than half the missile programs now under way* ● And its activities cover practically every stage of design, development, and production . . . including mechanical, hydraulic, pneumatic and electronic test equipment . . . auxiliary power supplies . . . field and depot handling equipment . . . launchers . . . ground and flight control systems ● See for yourself why AMF's experience in missiles, as well as in a host of other fields, has made it the "can do" company.

Research, Development, Production in these fields:
- *Armament*
- *Ballistics*
- *Radar Antennae*
- *Guided Missile Support Equipment*
- *Auxiliary Power Supplies*
- *Control Systems*

Another AMF Product
DEFENSE PRODUCTS

Defense Products Group
AMERICAN MACHINE & FOUNDRY COMPANY
1101 North Royal Street, Alexandria, Va.

This is the Temco QL-17 Drone



Now in use by the U. S. Army Signal Corps, this aerial drone is a part of a complete system developed by Temco. The system includes an L-17 aircraft modified for pilotless photo-television drone operation, a unique auto-pilot, and a ground-control station so compact that it can be transported by jeep. Training of Signal Corps pilots to operate the system was a part of the contract. This is a typical example of Temco's ability to build complete aircraft and complete weapons systems.

What is This?

It is a titanium ventral fairing, produced at Temco for the McDonnell F-101 Voodoo. This is one of a list of some 68 current Temco projects ranging from development and manufacture of complete aircraft to production of major assemblies for 14 first-line military and commercial aircraft. A major part in helping Temco earn contracts for this F-101 assembly and other titanium components has been a research program that developed improved methods for handling this most difficult of metals.

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RESEARCH AND MARKETING
Mary Whitney Fenton, Joan Read, Judith P. Wheeler

BuAer Adopts Weapon Systems Concept..... 26
▶Navy reorganizes research and development activity to help insure maximum weapon capability.

Jet Transport Orders Set Airline Future..... 38
▶Lockheed, Convair, Douglas, Boeing compete for medium-haul market; more orders seen for pistons.

Aero's 680 Embodies High Performance..... 82
▶Aviation Week flight shows five-seven place business plane has good altitude, speed capabilities.

Lack of Funds Slowed X-2 Development..... 34
▶USAF pilot tells Rocket Society members speed and altitude achievements should have been attained earlier.

MISSILE ENGINEERING

Navy Plans 200-mi. Rocket..... 29
Combustion Focus of Rocket Meeting 32
One-Stage Rocket for Space..... 34
Ships for Data Stations..... 37

AERONAUTICAL ENGINEERING

Italians Fly Twin-Jet Fighter..... 27
Trainer Shows Fang Influence..... 29
TF-102A Passes Mach 1 Smoothly.. 30
F-104 Orders..... 37
Why Bell Favors Three Turbines.... 49
Russian Theory..... 54
Red Model Designs to Wakefield... 55
Westinghouse Opens Laboratory.... 57

EQUIPMENT

JATO on Business Planes..... 62
Off the Line..... 71

BUSINESS FLYING

Cessna 620 Design..... 96

TRANSPORT

LaGuardia Control Improved..... 37
CAA Officials Fly in Boeing 707.... 40
U. S. Drops Foreign Travel Tax..... 40
More Pay for Controllers..... 41
New Nonstop Service Proposed..... 41
Lake Central Employes Win in Court 41
IATA Meeting Ends with Elections... 42
Sud-Est Plans New York Office..... 42
Shortlines..... 42
Airline Observer..... 43
Airline Income—July 1956..... 47

AVIONICS

Navy Establishes Avionics Division... 27

MANAGEMENT

Quarles Sees Defense Cost Rise..... 28
Pratt & Whitney Promotions..... 37
Report from Algeria, Part 3..... 73
Who's Where..... 23
Industry Observer..... 23
Washington Roundup..... 25

Calendar..... 5
Letters..... 118

EDITORIAL

Facing Jet Age Economic Problems.. 21

COVER: Aero Commander Model 680 demonstrated high performance to Aviation Week's Richard Sweeney (see page 82). Model 680 is powered by two supercharged Lycoming GSO-480-A1A6 engines that give it extra altitude capability and top speed of 260 mph. Scene is near plant of Aero Design and Engineering Co. at Bethany, Okla.

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Facing Jet Age Economic Problems

There are unmistakable signs that jet age air transport will bring an economic revolution in the airline business far more difficult to handle than the technical problems on which the air transport industry is now concentrating so hard. This concentration on striving for solutions of formidable technical problems posed by jet transport is vitally necessary. After several years wailing over the horrendous aspect of these problems, it is extremely encouraging to see sound technical development and realistic cooperative thinking taking over from the prophets of doom who saw nothing but ear-splitting noise, 15,000-foot runways and three-hour traffic stacks with the advent of jet transport operations. Technical progress on reverse thrust devices, silencers plus electronic navigation and traffic control equipment indicates that some practical solutions to these technical problems can be in hand before they become acute in the early 1960s.

Sales, Traffic Problems

However, airline management has been less perceptive perhaps than its operations executives in sensing the outlines of the economic revolution that will shake the industry to its foundations unless the same energy, realistic thinking and foresightedness are devoted to the sales and traffic problems looming ahead. There can be little doubt now that the key to the jet transport era is the mass transportation market.

Airlines already have passed out of "the airline business" into the mass transport business, but their current traffic volume is only part of the volume required to fill jet transports capable of carrying 150 people across the Atlantic twice daily. The whole economic structure of the airlines must be geared to getting high traffic volume flowing smoothly through international systems.

First and foremost this traffic volume problem will revolve around a new rate structure. This fact is pretty well accepted now by airline managements as one of the really thorny problems to solve during the next few years. Variety of airline equipment operating in the jet age will further complicate the fare picture. Piston engine transports will continue to operate in some types of service. Turboprop transports will offer compromise between speed and price while turbojets place full premium on speed.

The only thing that appears certain in the future fare structure is that travel by air under certain conditions will become cheaper and cheaper until gas turbine powered transports will become competitive with cheaper surface transports, such as buses, on a price basis alone even without a premium of speed. While airline salesmen are out selling the mass market airline tickets, somebody is going to have to devise some new, streamlined methods for keeping track of reservations, ticketing and handling of passengers at terminals. Present methods already are severely strained by contemporary traffic volume, as anybody who has wrestled around LaGuardia, Idlewild or Chicago Midway airports can testify. The whole process of making reservations, selling tickets and getting passengers with baggage aboard the aircraft must be simplified and speeded. Surface transport to and from airports, a perennial bottleneck, must also be broken. We recently noted a cartoon in a British publication showing a busload of passengers en route to London Airport caught in a traffic jam and being served inflight meals by a stewardess. In many large cities now things are just about that bad.

Another major problem already becoming acute but certain to be critical in the jet age unless prompt action is forthcoming is what to do with passengers abroad since practically no hotels have been built in postwar Europe. Present capacity is just about saturated by the current influx of airborne tourists during the summer season. Recently the American Bar Assn. planned its annual convention for London. On investigation the bar found it could provide only 2,500 hotel rooms in London out of a requirement for 7,000. The convention was switched somewhere else with more hotel capacity.

Hotel Building

Somebody will have to follow Conrad Hilton's example by building more modern hotels throughout Europe, Africa and Asia. We know several airlines are planning to build their own hotel chains to accommodate their passengers. With the increase in popularity of Americans driving cars through Europe but using airlines for the long transatlantic haul, provision for motels throughout Europe also is a fertile field for hotel men.

During the past decade, enormous improvement has been made in eliminating red tape involved in customs, immigration and public health procedures for air travelers. However there still is considerable room for improvement, particularly in eliminating meaningless embarkation cards and documentation required for aircraft themselves and for air cargo.

There are no quick, easy solutions to economic problems posed by jet air transport. Fortunately, a few years remain before these will become acute. But now is the time to face them and begin working out practical solutions. By exhibiting a statesmanlike approach to these problems, making very clear that the airline aim is the best possible service to the traveling public at the lowest feasible cost, the air transport industry can offer its best defense against government bureaucrats promoting fare investigations or politicians seeking personal publicity with false charges of "monopoly and cartel."

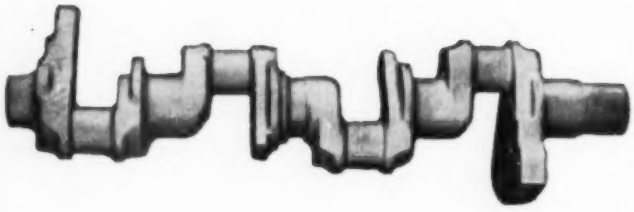
—Robert Hotz

whether you think in terms of

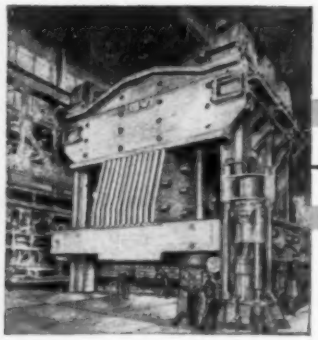
Horsepower

— or —

Thrust



The crankshaft is the backbone of the piston-type engine. Illustrated above is the crankshaft forging for the most powerful piston-type aircraft engine ever produced.



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WHO'S WHERE

In the Front Office

Edward P. Gillane, president, Pratt & Whitney Company, Inc., West Hartford, Conn. He succeeds **Alexander H. d'Arcambal** who is retiring as president and general manager; Mr. d'Arcambal will remain active in the company as a consultant and honorary chairman of the board.

John T. Ryan, Jr., president, and **Edgar G. Sanner**, executive vice president, newly formed MSA Research Corp., a subsidiary of Mine Safety Appliances Co., Pittsburgh, Pa. Also: **Dr. C. B. Jackson**, vice president and director of research.

Erich Schatzki, president and a director, Liberty Products Corp., a subsidiary of Penn-Texas Corp., Farmingdale, N. Y. He succeeds **Robert Simon**, who will continue as a consultant and a director. Also: **Robert F. Fresh**, treasurer and controller.

Edward L. Farrell, Jr., vice president, Pan American-Grace Airways.

W. W. Gilmore, vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. Mr. Gilmore will continue as president of the company's Micro Switch Division.

James P. Malmstron, vice president, United Aircraft Products, Inc., Dayton, Ohio.

Harold H. Gillespie, Emil J. Karkut, and **Raymond S. Mann**, vice presidents, Barden Corp., Danbury, Conn.

Honors and Elections

Dr. Charles F. Kettering has been unanimously selected as the industrialist of the year by the Society of Industrial Realtors and will receive the Society's 1956 Industrial Award Trophy.

Six prize scholarships, for freshmen entering Massachusetts Institute of Technology to study aeronautical engineering, have been established by Mrs. John Jay Ide of New York in honor of her father, the late William H. Donner. First recipients of the William H. Donner scholarships are: **Thomas V. Brown**, Ocala, Fla.; **Craig M. Fletcher**, Los Angeles, Calif.; **Theodore C. Kraver**, Medina, Ohio; **Peter W. McLaughlin**, Hempstead, N. Y.; **Theodore J. Miller, Jr.**, Glen Cove, N. Y.; **Ronald D. Wendland**, West Union, Iowa.

Changes

Dr. Richard C. Raymond, manager, Technical Military Planning Operation (TEMPO) of General Electric Company's Defense Electronics Division. Headquarters for TEMPO will be established in Santa Barbara, Calif.

James E. McLarney, agency and interline manager for North America, Lufthansa German Airlines.

Francis A. Bickel, assistant treasurer, United Air Lines. He succeeds **D. C. Meenan**, now general manager-Facilities and Property Dept.

Curtis F. Fincham, assistant to the vice-president-sales, Canadair Ltd., Montreal. Mr. Fincham will head a new liaison office in Ottawa.

INDUSTRY OBSERVER

► Lockheed is considering splitting its California Division into two separate branches, one devoted to military projects, the other to commercial ventures.

► **First of three Lycoming T53-powered Bell XH-40 helicopters is nearing completion. First flight is expected before the end of the year, approximately 17 months after the beginning of the development program. An additional XH-40 static test vehicle also is being completed. The company expects to receive a contract for six YH-40 service test aircraft in the near future.**

► Japan's Air Self Defense Force is considering purchase of Folland Gnat lightweight fighters. Evaluation may take place next year.

► **Lockheed F-104A has completed Phase II flight tests at Edwards AFB, Calif. Tests were completed approximately one week ahead of schedule.**

► Two Cessna T-37A jet trainers have undergone accelerated test programs at Edwards AFB, Calif. One plane put in 31 hr., 35-min. flight time; the other 24 hr., with the latter undergoing an engine removal, repair and replacement.

► **Air Force has placed a procurement order for at least 50 skin mills and profilers that will be numerically controlled. Major aircraft companies are scheduled to receive the orders, and delivery is expected to begin in late 1957.**

► Beech jet Mentor primary trainer has undergone complete overhaul at the Wichita, Kan., factory prior to being sent to Pensacola Naval Air Station's Air Technical Training Unit for further evaluation. Mentor already has undergone tests at the Naval Air Test Center, Patuxent River, Md., and will be taken to Fort Rucker, Ala., early this week, where selected pilots from the Army Aviation Test Board will be given indoctrination flights. It also will be looked over by Army pilots at Fort Belvoir, Va.

► **Nord Co. has flight tested the latest version of its Nord 2501 military cargo plane. The new version, designated the Nord 2506, is equipped with two Turbomeca Marbore booster units, two air brakes fitted at the rear of the main fuselage and new type flaps. The main landing gear also can be adjusted to facilitate ground cargo loading.**

► De Lackner Aerocycle is undergoing evaluation trials at Fort Eustis, Va. Thus far, the Aerocycle has not been flown out of ground effect but is scheduled to do so soon in a tethered flight.

► **Sud-Est Aviation production of the Alouette II helicopter at the Courneuve plant is expected to hit a monthly rate of 10 by the end of the year. Ultimate production goal is 15.**

► Decca navigation system will be installed by Bell Aircraft Corp. at its Fort Worth Helicopter Division to study the equipment's efficiency in helicopter operations and to evaluate some of the special instruments developed by Bell.

► **Air Rescue Service is pressing USAF research and development agencies for funds to fulfill a requirement to equip its fleet of Grumman SA-16A Albatross amphibians and Douglas SC-47 rescue planes with Safe-Flight speed control equipment.**

► Shin-Mitsubishi Heavy Industries Reorganized of Japan assembled and test flew its first F-86F approximately one month ahead of schedule. The Sabrejet was assembled from parts imported from North American Aviation, Inc.

► **Line-of-sight barrier, previously thought to limit UHF-VHF ground-to-air communications to maximum range of 200 miles, may be broken by application of "scatter" techniques similar to those used for trans-horizon ground-to-ground communications. Air Force Cambridge Research Center studies indicate feasible range of 400 miles with suitable high-power ground stations.**

SAS
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Scandinavian Airlines System—*the Global Airline*—has selected Link Aviation, Inc. to build its first flight simulator for the forthcoming Douglas DC-8 airliner.

Link's amazing DC-8 Simulator will accurately reproduce the cockpit and flight characteristics of the mighty four-jet Douglas transport. SAS pilots and crews will develop flight proficiency *on the ground*, before actual delivery of the airplane.

The new Link Simulator will incorporate up to the minute Link developments such as d-c computation, linear interpolation and automatic amplifier checking—advances which make training in flight simulators even more realistic, even better than ever before.

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Washington Roundup

Satellite Perspective

As the man whose office is responsible for providing the means for launching an artificial satellite before the end of 1958, Dr. Clifford C. Furnas, Assistant Secretary of Defense for Research and Development, is not underestimating the job.

He calls the plan "a noble resolve for a noble experiment," but points out that "there is a great gap between dreams and reality." Although he is pleased that the United States "accepted the challenge" and believes that satellite research "will eventually lead to tremendous practical benefits to the human race," he insists it is "not yet time to stand in line to buy even one-way tickets to the Moon."

"This task . . . is one of the most difficult ever undertaken by a body of scientists and engineers," he told an American Rocket Society meeting. "It is no casual, backyard piece of experimentation. . . .

"There is a reasonable probability—though allow me to emphasize strongly that there is no true assurance of success—that the schedule will be met."

Dr. Furnas noted that present plans call for six preliminary rocket systems for test purposes and six complete rocket guidance-and-control systems for actual launchings.

"The probability that all six of these will be completely successful is very small," he said. "I do feel, however, that the probability of getting at least one into the orbital position is quite good."

Brucker Accepts Cuts

Despite the absence of leaks as top Pentagon military and civilian officials study upcoming changes in the armed forces, there is evidence of a serious struggle over who will shed the most blood when the economy axe strikes. Evidence during reactivation ceremonies for the 101st Airborne Division indicates that Army Secretary Wilber Brucker has already accepted the political line that his ground forces will be slashed and that the USAF will help make up for it by putting more of its budget into air lift. Gen. Maxwell D. Taylor, Army Chief of Staff, nods his head in agreement with Brucker's statements of confidence in USAF. But he does so without enthusiasm.

In his looking glass, Brucker sees four streamlined and air transportable divisions with USAF wings to move them. He denies this will call for four times the air lift needed by one division such as the 101st, but other sources speculate that such a program would necessitate a massive increase in the Tactical Air Command's transport fleet. Educated guesses run in the neighborhood of 2,000 C-119s and at least 1,200 C-124s or their equivalent in more modern aircraft. Army's optimum is to have all this equipment earmarked for Army use only. That USAF can provide this kind of service, probably at the expense of combat aircraft, is highly problematical. Says one high USAF officer: "How can the Army justify this program? From our viewpoint, it is high cost, low utility and at least in the early stages of another war, just no good."

Confusion Among the Irregulars

The U.S. Court of Appeals has refused to reconsider its decision to send the Large Irregular Case back to the Civil Aeronautics Board for further action. The decision will now be appealed to the Supreme Court. The Air Coach Transport Assn. and the Independent Military Air Transport Assn. have asked the Court of Appeals to stay its judgment until they can apply to the Supreme Court for review of the lower court decision. The CAB also has asked for a stay while it decides whether it will carry the argument on to the Supreme Court.

The Court of Appeals sent the decision back to the CAB because it objected to the way the Board issued the new supplemental air carrier authority last November. The Court did not question the authority itself but said the CAB failed to prove that it should issue the new authority as exemptions rather than making the carriers go through a full certificate proceeding in order to become supplemental air carriers. In the case, the CAB established a new class of supplemental air service to replace operations of large irregular carriers.

KLM's War of Nerves

KLM Royal Dutch Airlines stepped up its war of nerves against the American government in general and the U.S. airlines in particular last week with a transatlantic press conference held over the telephone cable opened last week between the U.S. and Europe. Talking from The Hague to two dozen American reporters, KLM President I. A. Aler termed U.S. refusals to let KLM serve Los Angeles and Houston as short-sighted and said that closing doors on KLM and other foreign airlines will eventually result in doors being closed to U.S. carriers. Aler, in answer to a question, said the U.S. government is more restrictive than other governments in negotiations over air transport agreements and blamed the refusal to grant KLM's request on the opposition of American carriers.

The KLM president also told the newsmen that his airline doesn't fear competition and would welcome more of it from American carriers.

Answering Aler's gambit, Air Transport Assn. President Stuart G. Tipton said "generous" U.S. policies have allowed the Dutch airline to build a world-wide network on American traffic, an operation Dutch traffic alone could not support. He added: "After all this, it is astonishing to hear of our government's policy referred to as restrictive, or to receive threats of retaliation abroad against American-flag airlines."

KLM has been conducting an intensive campaign to get into Houston and Los Angeles for months. Talks between U.S. and Dutch governments were broken off last spring after it became apparent they were getting nowhere. Of this, Aler said "the first act is finished, and the second act will start in a few weeks." He said he expects talks to be resumed in November.

Magnuson Victory

Sen. Warren Magnuson (D.-Wash.), chairman of the Senate Commerce Committee, showed surprising strength in the Washington State primary election. Magnuson stacked up a total 150,000 plurality over his opponent, Gov. Arthur Langlie on the Republican ticket, carrying 38 of Washington's 39 counties by substantial margins. Since neither candidate had opposition, the primary was primarily an indicative popularity contest.

The Magnuson-Langlie contest had been billed in newspaper accounts as one of the closest senatorial races. Langlie, keynoter at the Republican convention, was urged by President Eisenhower to run for the Senate seat.

—Washington staff

BuAer Adopts Weapon Systems Concept

Navy reorganizes BuAer research and development activity to help insure maximum weapon capability.

By Claude Witze

Washington—U. S. Navy's Bureau of Aeronautics has reorganized its research and development activity to adopt the Weapon Systems Concept with emphasis on strong management.

The goal is to shorten the cycle "from concept to fleet delivery" and insure maximum weapon capability.

Rear Adm. William A. Schoech, assistant BuAer chief for research and development, told AVIATION WEEK the changes mark the recognition of the fact that the state of the art is progressing at a fast rate and Navy's approach to new weapons must change to meet the challenges ahead. The stress in research and development, he said, will be placed on the following points:

- **Research and development planning** phases.
- **Project management** for air weapon systems.
- **Centralization,** increasing efficiency and economy.

Greater Role For Contractor

For the aircraft industry, it was made clear, this does not mean that a prime contractor will be given as much responsibility as he assumes under the Weapon Systems Concept as practiced by the Air Force. BuAer feels strongly that the environmental factors faced by Navy weapons call for tighter control over designs than that which can be allowed for land-based aircraft.

The Navy indicated that the whole procedure of source selection faces a re-evaluation and that new changes can be expected in procedures for awarding contracts.

The prime contractor almost certainly will play a larger role in the Navy's consideration of what the state of the art will permit. It follows that BuAer soon will take manufacturers of proven capability further into its confidence. This sharing of military secrets, like the Weapon Systems Concept itself, is a practice already pioneered by the USAF's Air Research and Development Command.

A secondary facet is that BuAer, again like the USAF, wants to encourage greater research and development efforts by industry. The new organization is designed to make this easier.

Under Adm. Schoech, the engineering work is controlled by three major officers, covering component development, support equipment and weapon systems.

Weapon Systems is responsible for work on aircraft, guided missiles and aircraft nuclear propulsion.

Avionics Division Formed

Major innovation here is the creation of a new Avionics Division, reporting directly to Capt. T. A. Ahroon, the component development officer, recently selected for promotion to rear admiral.

Heading the division is Capt. W. E. Sweeney.

The division will dovetail all operations through three major staff branches —Administration, Plans and Liaison and Fiscal—and four line branches—Weapons System Management, Weapons Delivery Systems, Weapons Support Systems and the former Fire Control Support Branch of the Bureau of Ordnance.

Adm. Schoech told AVIATION WEEK that there will be a "program manager" named for each new weapon system, corresponding in most respects to USAF's Weapon System Project Officer (WSPO).

This man, with the combined talents of engineer and administrator, will be given the authority necessary to make decisions.

Similar delegation of authority, equal to the responsibility vested in a job, will be passed down the line. This is designed to overcome common complaints of red tape and the inevitable desks piled high with papers awaiting action.

Authority Plus Responsibility

Under the program manager for any project, there will be a Research and Development Project Officer, a Contracts Project Officer and Maintenance Project Officer. By giving these men authority along with their responsibility, and competent staffs with which to work, it is anticipated that Navy weapon systems will be kept closer to the current state of the art.

Long-range development planning will be improved by BuAer's research and development organization through a Plans and Progress Officer, serving on the staff of Adm. Schoech in close cooperation with a Research & Analysis Officer.

One of the major immediate problems facing BuAer is the provision of a staff that is technically and administratively competent to furnish strong management for weapon systems development. Officers and civilians will be used, each carefully picked for his specific job.

In the case of uniformed personnel, it is possible that the BuAer tour of duty will be extended to at least four years.

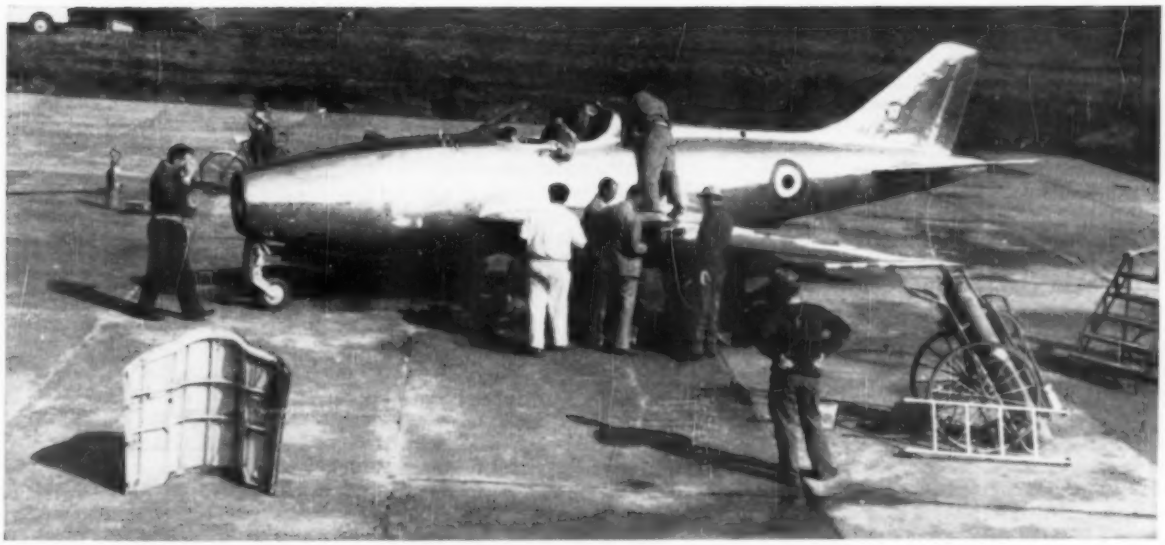
Earlier Reorganization

The new reorganization came almost exactly one year after BuAer's initial streamlining and expansion under the leadership of Rear Adm. James S. Russell (AW Sept. 5, 1955, p. 12). At that time, the research and development group was the only one left unchanged, as primary attention was directed towards improved procurement procedures.

New R&D Positions

New positions created by the Bureau of Aeronautics' reorganization of its research and development group include:

- **Plans and Progress Officer, responsible for formulation of long-range planning and implementation of research and development programs.**
- **Programs and Budget Officer, principal financial adviser in the formulation of the research-and-development budget and expenditures.**
- **Services Officer, coordination, collection, analysis and dissemination of general technical information; administrative matters (including space planning and security matters), and coordination of facilities, funding, personnel and workload.**
- **Research and Analysis Officer, planning, coordination, direction and control of broad theoretical research.**
- **Component Development Officer, planning, direction and control of research, design, development, test and evaluation of airborne components and equipment for aircraft, guided missiles and target drones.**
- **Support Equipment Officer, development and engineering of recovery equipment, launching, ground handling, visual landing aids and associated equipment.**
- **Weapon Systems Officer, administration of research, design, test and evaluation of all naval air weapon systems and application of nuclear propulsion to various types naval aircraft.**



Italians Test Twin Jet Interceptor

Italian approach to a light supersonic turbojet interceptor is the Aerfer Ambrosini Sagittario II here making its first flights at Pratica di Mare airport near Rome. Speed of Mach .94 was reached in the early flights at an altitude of 27,000 ft. Powerplants are described as two Rolls-Royce Derwent 9 engines rated by the Italians at 4,000 lb. thrust. Belly mounting of engines is discernible in takeoff picture. Housing for engines stands on ramp. Experimental Sagittario II is a prototype for Aerfer's Ariete, in which a Rolls-Royce Soar turbojet of 1,810 lb. thrust was to be used as an auxiliary engine to a single Derwent 9. Sagittario II was heavily damaged in an emergency landing, and repairs are now under way.

BuAer's New Avionics Division Streamlines Its R&D Activities

By Philip J. Klass

Washington—The Navy Bureau of Aeronautics' newly formed Avionics Division is intended to eliminate problems of divided responsibility which have plagued both the Navy and its avionics-airframe contractors. The new Avionics Division brings together under one roof the R&D activities formerly assigned to two separate BuAer divisions (Armament and Electronics), plus those assigned to Bureau of Ordnance and a few programs formerly in the Airborne Equipment Division.

Capt. W. E. Sweeney is director of the new division. Sweeney was chief of the former Electronics Division and prior to that was head of the Armament Division.

To provide better integration of the many complex avionic sub-systems used in aircraft and missiles, the Avionics Division has formed a group of weapon system managers, each assigned to one or two weapon systems. The group is headed by Col. L. F. Fox (USMC). Each weapon systems manager will coordinate the R&D of the many subsystems needed for his weapon system and will serve as a central point of contact for aircraft-missile contractors and Navy aircraft-missile project officers.

In addition to this new management

Emphasis a year ago was on speeding and improving BuAer's relationships with industry.

That shakeup was made on the eve of a congressional probe into the Bureau's $200 million "error" in the McDonnell F3H-1 Demon and Westinghouse J40 engine programs (AW Oct. 3, 1955, p. 12).

Navy spokesmen said the new changes in the research and development unit have been under consideration for more than a year. By coincidence, they follow closely recommendations made by the Defense Department's Aircraft Study Group, calling for a strengthening of the lower echelons of military procurement authority (AW Sept. 17, p. 26). In particular, the Study Group urged more power to make decisions for USAF's Weapon Systems Project Officers and Navy class desks.

group, the Avionics Division consists of three other "line" groups, two of them responsible for sub-system R&D, and the third in a special support role:

• **Weapon Delivery System,** headed by Cdr. R. J. Schneider, consists of four branches: Fire Control, Weapons (both formerly part of the Armament Divisions), Radar and Missile Guidance & Control, which came from the old Electronics Division. Former BuOrd responsibilities for R&D in the field of bombing systems gunsights, and some fire control systems has been transferred to the new Fire Control Branch, making the latter now responsible for all types of fire control systems. The Weapons Branch is responsible for fuses, warhead arming, bomb racks and associated weapon controls.

• **Weapon Support Systems,** under Cdr. F. L. Faulkner, also consists of four branches: Electronic Countermeasures (ECM), Communications-Navigation-Identification (CNI), Underwater Search - Detection - Classification (USDC), and Technical Support. The ECN, CNI and USDC branches came from the former Electronics Division, but with expanded responsibilities. For example, airborne dead reckoning computers, droppler auto navigators, and inertial guidance, formerly assigned to BuAer's Airborne Equipment Division, now are part of the CNI Branch. The Technical Support Branch will develop maintenance test equipment and specifications for all seven branches in both the Weapon Delivery and Weapon Support Systems groups.

• **Fire Control Support,** under Lcdr. R. W. Laughhead, is a group that was transferred from BuOrd where it performed the supply, maintenance and production control tasks connected with BuOrd's bombing and fire control systems. This group has no direct counterpart for other Avionics Division equipments because most of these same functions are performed by BuAer's production division, Capt. Sweeney told AVIATION WEEK. However, rather than risk interruption of these vital services in the reorganization by attempting to split up the group and integrate it into several BuAer divisions, the Fire Control Support Group was transferred intact to the new Avionics Division. In time, as existing BuOrd systems are replaced with newer developments, the activities of the Fire Control Support Group may be directed into other channels.

In addition to the four line groups, the Avionics Division has three staff functions:

• **Plans,** under Cdr. L. C. Powell, Jr., works with BuAer's Asst. Chief for Plans to determine avionic developments needed for future airframes and missiles.

• **Fiscal,** under Cdr. J. C. Kemp, handles budgetary matters and program scheduling.

• **Administration,** under Cdr. L. Morse.

The recent reorganization of BuAer's R&D activities, and the formation of the new weapon systems management group, has not altered BuAer's policy on whether avionic sub-systems should be furnished by the contractor or the government, Capt. Sweeney told AVIATION WEEK.

BuAer's policy on CFE versus GFE for avionics will continue to be a flexible one, decided on an individual weapon systems basis depending upon the particular circumstances. BuAer also has pioneered a sort of middle course in its CNI (Communication-Navigation-Identification) package which combines the logistic and maintenance advantages of GFE with the form factor flexibility which makes CFE attractive to airframe producers. Standard avionic CNI equipment, in small modular sub-assemblies, can be packaged into almost any desired form factor.

This same principle may be applicable to other equipment and sub-systems, according to Dr. L. H. Glassman. Glassman and J. M. Brearley are technical assistants to Capt. Sweeney.

Several of the R&D responsibilities of the old Armament and Electronics Divisions have not been included in the new Avionics Division. The former Electronics Division Electrical Branch has been transferred to the Airborne Equipment Division together with tow targets and aircraft armor, formerly under the Armament Division.

The new BuAer Division will have the following BuAer facilities under its cognizance:

• **Naval Avionics Facility,** Indianapolis.

• **Naval Air Mine Defense Development Unit,** Panama City, Fla.

• **Naval Air Special Weapons Facility,** Albuquerque, N. M.

• **Armament & Electronics Laboratory,** Naval Air Development Center, Johnsville, Pa.

• **Armament & Electronics Test Laboratory,** Naval Air Test Center, Patuxent River, Md.

Quarles Predicts Further Rise In Defense Spending Next Year

New York—Air Force Secretary Donald A. Quarles told industrial leaders meeting in New York last week that spending for defense now is at a record rate and it probably will increase next year.

"This year the Air Force will expend something like $17 billion," he said, "but because the present year will bring us into a position to capitalize on results of important developments in a variety of fields, our expenditures next year will require a substantial increase."

Adm. Arleigh A. Burke, Chief of Naval Operations, told the same group that this "is a good time, I think, to remind ourselves that all these new ships, new airplanes, new weapons, tremendous missiles, are going to cost money—big money."

Burke addressed a luncheon of the 2,000 industrialists attending a meeting of the National Security Industrial Assn. at the Waldorf Astoria, and Quarles was speaker at the evening banquet.

Quarles explained that much of the spending increase will be caused by quantity production of components for the nation's air defense system – the DEW line and SAGE; by the long-range missile program now approaching the hardware stage; by just-beginning production of air-breathing missiles of intercontinental range, and in general by the maintenance of a first-class Air Force in being while attempting to achieve new development programs.

"For several years then," he said, "we must concurrently continue to modernize our existing forces of manned aircraft and facilities for their employment.

"While making a strenuous effort to achieve missile capability, we must build up production of the B-52 and jet tankers to support them, as well as a variety of other aircraft types which are coming along to replace our older fighter, bomber and cargo models."

Another factor in the increased costs, Quarles said, is the present Air Force program of providing additional housing and other conveniences at air bases, "which is mandatory if we are to achieve and maintain the level of skill needed to operate the kind of Air Force we have been talking about."

Quarles pointed out that the Air Force alone today is spending substantially more for research and development of new weapons than the whole military establishment was spending before Korea.

"Moreover," he added, "for each three dollars we spend today for inventory we spend another dollar for development of better things for the follow-on inventory."

Quarles said the United States currently is spending about 10% of its gross national income on military security, including military assistance to its allies, and there appeared no likelihood in the near future of a lesser drain on the nation's resources.

"As a matter of fact," he maintained,

"we are competing with a nation of vast manpower and material resources that is currently devoting some 15% of its gross national product to its military establishment and another 25% to build up its heavy industry and thus increase its military potential. Moreover, technologically speaking, this is no longer a backward nation. I need not detail to you the scope of Soviet activity in the military field. We all recognize that they have been moving up very rapidly; that they have the means to inflict widespread destruction upon the United States and they may before long augment this capability with long-range ballistic missiles."

(With the Soviet gross national product estimated unofficially at $150 billion, Quarles' comparison would amount to a $22.5 billion Russian defense expenditure.)

Quarles said that the cost of maintaining our air/atomic capability is going up in spite of the defense concept of not necessarily matching the Soviets plane for plane and missile for missile.

"We will modify our force structure as necessary to take advantage of new developments," Quarles stated.

Burke told the gathering the United States had no choice but to keep its deterrent forces strong, modern and diversified.

"As principal naval adviser I will say this," he added. "Take a long careful look at the globe . . . what goes on out there on the oceans in the years ahead will have a greater effect on the survival of the United States and the entire Free World than it has ever had before. We simply cannot afford to neglect it—even a little bit."

Commodore John K. Richards, USN, retired, announced he would step down Sept. 30 from the executive directorship of the NSIA. Capt. Robert N. McFarlane, USN ret., will succeed him.

Navy Research Rocket Planned for 200 mi.

Washington — Atlantic Research Corp., of Alexandria, Va., is developing for the Navy a single-stage solid propellant upper air research rocket—the Iris—for use at altitudes up to 200 mi.

The lower cost and ease of handling and storage of the solid propellant Iris may make it the successor to the Navy's liquid propelled Aerobee-Hi research rocket.

The 23-ft. Aerobee-Hi, which uses a short booster, carries a payload of 150 lbs. instrumentation to roughly 180 mi. Iris, which will be approximately 13 ft. long and about one ft. in diameter, will carry 100 lb. By the time the Iris is ready for research use, sub-miniaturization of instruments should make its 100-lb. load equivalent to the present 150-lb. load, a Navy spokesman said.

Iris is expected to reach the flight stage sometime in 1958.

Both Iris and Arcon, a single-stage solid propellant rocket about one foot shorter and about half the diameter of the Iris, are being developed for the Naval Research Laboratory on a Bureau of Ordnance contract. Arcon is designed for use at altitudes of 60 to 70 mi.

The fin-stabilized Iris probably will be fired from launching towers 20-to-30 ft. long, compared to the 140-ft. towers for the Aerobee-Hi. For some special tasks, Iris may be fired as a first stage, with smaller rockets in its nose.

Navy is interested in Iris' possibilities for shipboard use, where liquid propellants are not considered feasible. NRL scientists would like to take upper air soundings at a number of latitudes and longitudes and at widely scattered points during eclipses.

Most Aerobee-Hi research now is being done at the White Sands, N. M., proving ground.

Northrop Unveils Trainer Design

Hawthorne, Calif.—Designed for maximum growth and quick mission switch through component interchangeability under the design philosophy of Engineering Vice President Edgar Schmued, Northrop Aircraft's supersonic trainer also will have fighter plane capabilities.

Outstanding features of the aircraft, the N-156-T, include:

- **Two small turbojets** of the low frontal area, high thrust-weight ratio and low fuel consumption class are mounted in the empennage for quick change and maintenance without extensive airplane disassembly.
- **Horizontal flying tail** which is mounted almost level with the wing and has about 2 deg. of anhedral.
- **Area rule** is designed into the fuselage.
- **High aspect ratio** wing of approximately 3 to 5% thickness uses small span, deep chord ailerons, mounted well inboard of the usual aileron position, for good supersonic control.
- **Fuselage belly line** which has a reverse upward curve in the fuselage area rule region, giving the airplane porpoise-like appearance when viewed from the side.

Schmued's philosophy, basis of the trainer design, makes the dual fighter-trainer role an obvious conclusion, since it results in a basic airframe with almost every item of equipment, from powerplant to avionic, easily removable and interchangeable with similar but better counterparts. Under this thinking, the trainer and its equipment could be the basis of a weapons system. Space and weight for the other occupant can be equated out in added avionic gear (armament will undoubtedly be part of the basic trainer), or fuel for greater range can be added and a higher gross takeoff weight permitted. Complementing this projection would be engines of higher thrust at the same weight.

Many features have been carried over from the Northrop Fang mockup, (AW June 4, p. 38). Predominating is the possibility of multiple applications without basic airplane modification, by use of field or first or second echelon maintenance installed kits, enabling the airplane to resume its role as a trainer at will, and with minimum out-of-service time and expense incurred in changing the airplane up or down from the trainer version.

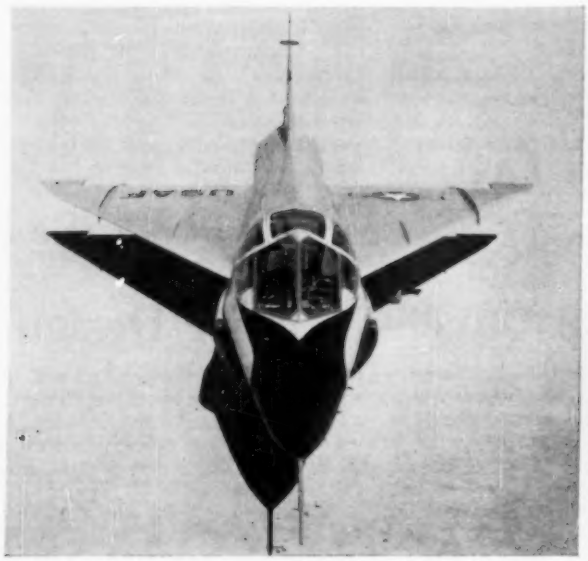
From front to back, the airplane is laid out for avionic gear in the sharply pointed nose, tandem crew compartment, fuel area and center of gravity (since the wings are located here, about two thirds of the way aft from nose to tail), and the engines and empennage. Engine installation results in a rectangular, boxy tail appearance, with the rear face flat except for the two jet tailpipes.

Viewed from above, the airplane has a high fineness ratio extending back through the main fuselage. The engine air intakes are located about halfway back below the fuselage centerline, extending rearward and curving inboard in the area rule section, and curving back outboard again at the engine installation. Inlets are slanted down and back, and boundary layer bleed is used.

Low wing, which has no dihedral, has a straight, sharply swept-back leading edge, full fairings at the fuselage junction which extend back almost to the horizontal tail location, and a trailing edge which sweeps forward about 2 deg. Planform reminds one of the McDonnell F-101 when the fairings are included in the view, although there is no great similarity in any particular section.

Side view shows the airplane to be shallow in depth, the greatest thickness being in the cockpit area. The canopy is faired backward, the fairing continuing to the vertical stabilizer, which is large and swept back in both leading and trailing edge, more so than the horizontal stabilizer.

Canopy is in three sections—windscreen, front compartment and rear compartment—with just one structural member outside that at the windscreen junction, located between the front and rear crew compartments. Rear seat is higher than the front one, for good visibility during landing. Ejection seats are incorporated.



CANOPY redesign incorporated vortex generators (right) fore and aft on top of canopy to smooth flow of air, lessen buffet.

TF-102A Passes Mach 1 Region Smoothly

By Richard Sweeney

Edwards AFB, Calif.—Despite the large canopy enclosing the side-by-side seats, Convair's TF-102A makes the transition from subsonic to supersonic flight smoothly and without necessity of using the airplane's stability augmentation system.

The bulging enclosure does require a slight nose down attitude, approximately 3 to 5 deg. in the transition. There is no buffet in the transonic region. An area of slight buffet is met between Mach .83 and Mach .86, but once this is past, and up to Mach 1.2, fastest the airplane was flown on this flight, no additional buffet is encountered.

In the early two-place airplanes, severe buffet problems were encountered at the canopy. These have been largely solved by canopy redesign, structural beefup and installation of vortex generators to smooth airflow over the cockpit enclosure area. In an early tuft test flight, the tufts just aft of the canopy were observed to point straight forward, but vortex generators have minimized this situation.

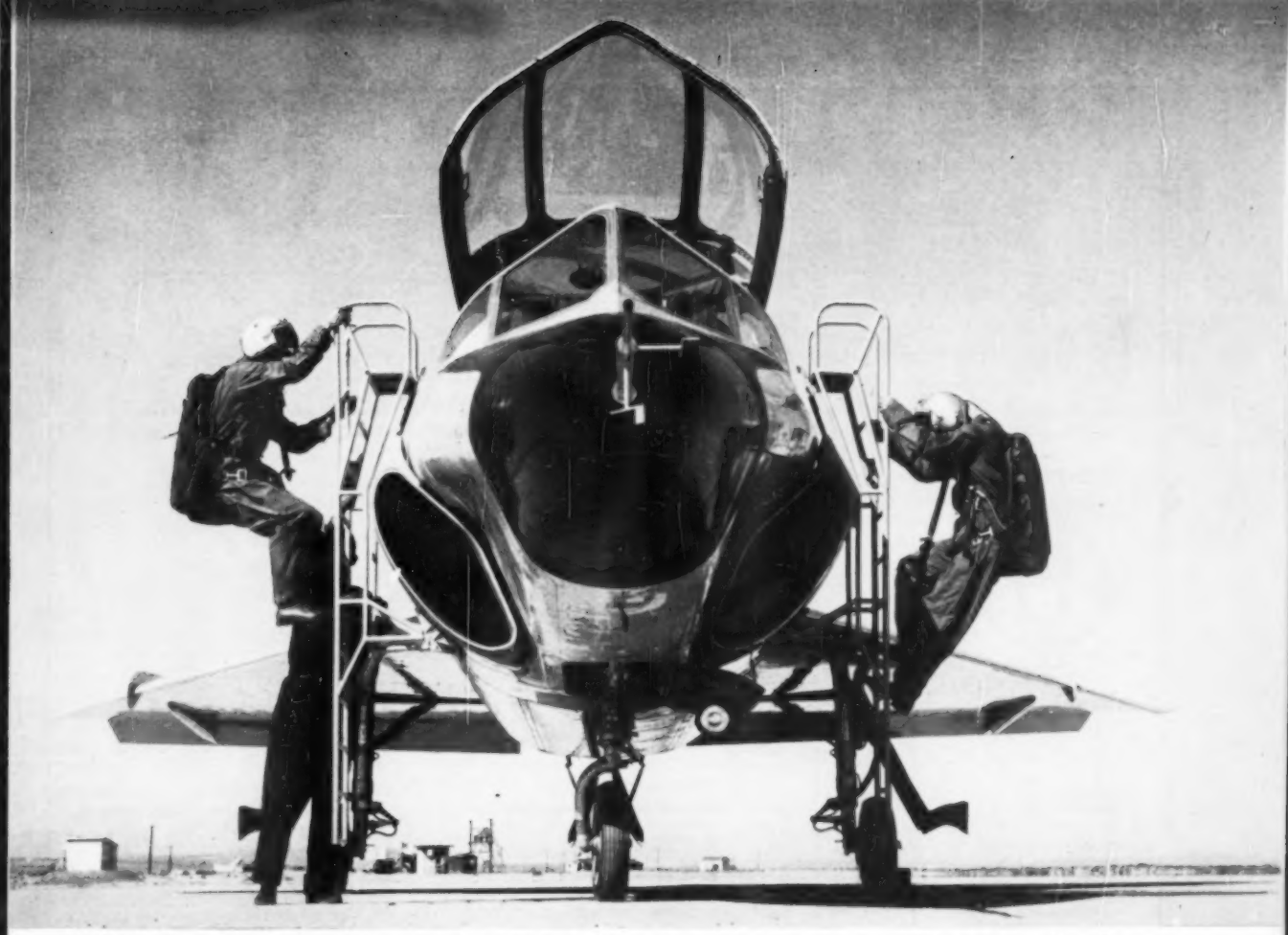
The airplane incorporates hydraulic flight controls with built-in "feel." Extremes of control travel require high manual pressures, insurance against extreme surface deflection without the pilot realizing exactly what is occurring. Stability augmentation system (trim servos), is in three axes, each switch-operated for on or off as the pilot desires.

Utilizing the aerodynamics of the delta configuration, the airplane can make steep turns at high altitude (above 40,000 ft.), in small radii compared with conventional swept wing designs. High accelerations are possible with the airplane, in line with its mission as an interceptor.

The airplane flown, which incorporated the larger vertical tail, was easily maneuvered through point as well as continuous rolls. Stability in 90 and 270 deg. positions of four point rolls with the large vertical surface was very steady with no falloff tendencies.

As the airplane decelerates through the Mach 1 region, a slight noseup

ALTHOUGH TF-102A presents a picture of nose high attitude during takeoff and landing, this is almost unnoticeable inside cockpit.



TF-102A has intakes moved downward, more flushed with fuselage than F-102. Note downward curve of delta wing leading edge.

tendency is encountered, one which again can be held against control forces without trouble, or can be trimmed out easily.

In the supersonic regime, the airplane exhibited no tendencies to vary from its track in any axis.

The TF-102A uses a Pratt & Whitney J57 engine with afterburner, a feature of which is comparatively low exhaust gas temperature during starting. Usually the exhaust gas temperatures will go higher than 250C, returning to 200C once the engine is at idling rpm.

With its excellent visibility and a hydraulically steerable nosewheel, the airplane taxis very easily using rudder pedal steering at engine idling rpm. of 60%.

Viewed from the ground, the airplane presents a picture of extremely nose high attitude during takeoff and landing. Inside, this is almost unnoticeable. In the takeoff and landing attitude, the nose is almost level from the pilot's view, instead of being high as in other small high performance airplanes, resulting in an overall impression of good visibility and erasure of the effects of the airplane's actual attitude.

The nose is lifted clear at about 100 kt. IAS, in takeoff and the airplane allowed to fly off. The aircraft has a very good acceleration rate. Power is used until the landing is committed (on short final tactical approaches), and the airplane is usually touched down at 125-130 kt. IAS.

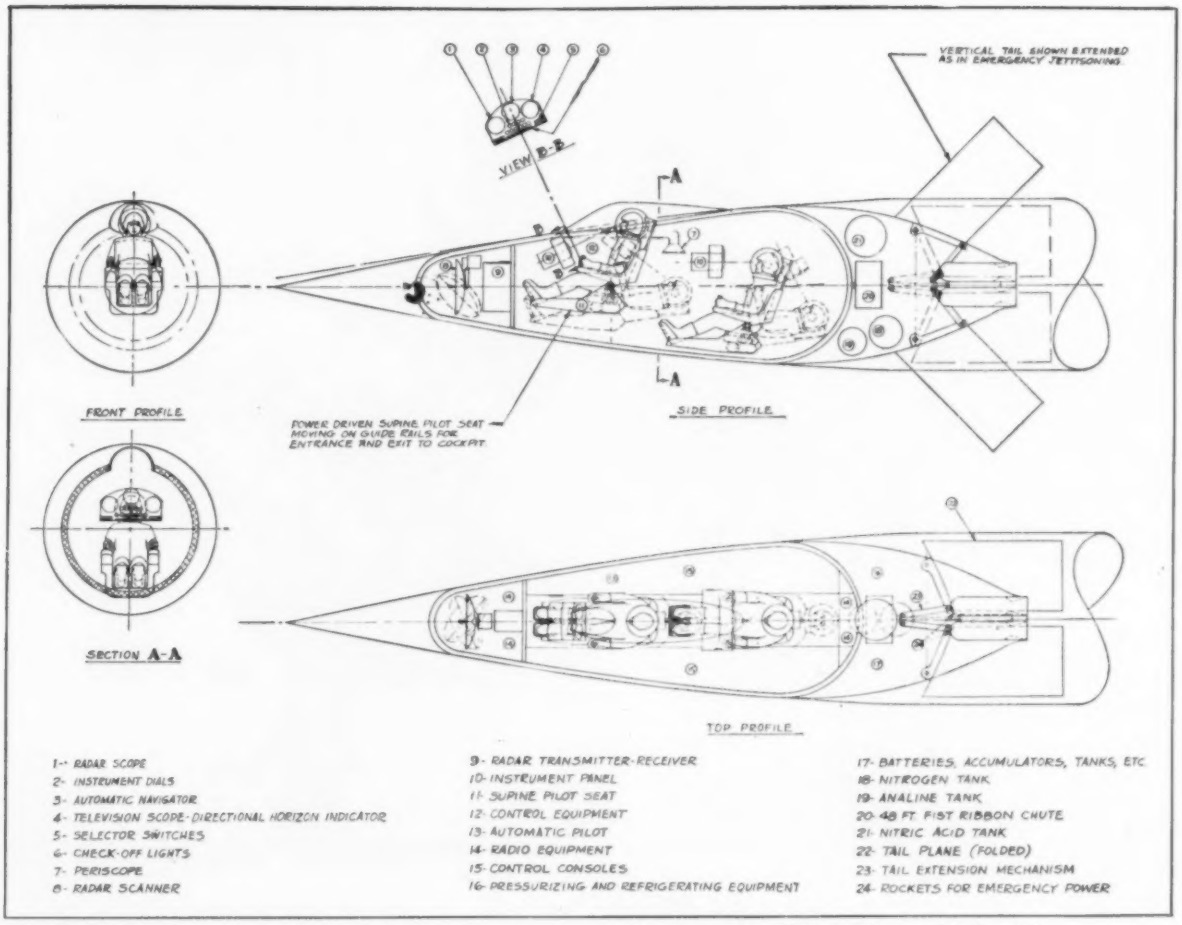
The drag chute was not used in this instance, but the airplane still decelerated well within distances of conventional jet-length runways.

USAF has broken further the time honored trainer seating pattern from tandem to side-by-side in the TF-102A. The penalties and advantages can be clearly seen as compared with the tandem seating arrangement. Side-by-side seating means greater drag and consequent subsonic speed in straight and level flight as against the supersonic straight and level speeds which a tandem airplane would be expected to attain.

However, placement of the instructor and trainee side-by-side enables the instructor to make his points clearly—by reference to instruments during the maneuver in question, by hand movements illustrating the maneuver and by utilization of the dual fire control installation to point out better techniques in flight and enable the trainee to accomplish them under guidance and repeat them if necessary, during the same flight.

Another airplane designed on this same theory is Cessna's T-37, first jet trainer the USAF cadet will enter in future training. From first flight in North American's T-28 piston powered tandem airplane, he will move to the side-by-side T-37 for his first jet training where the instructor can probably accomplish more per flight hour than is possible in the tandem airplane.

For the TF-102A, present plans are for one per base where Air Defense Command squadrons are using the F-102A. The trainer version has the same weapons capability as the combat model, insuring that a complete mission can be accomplished with the two place airplane for training as well as actual combat, while the transitional training capability also will add greatly to the ease and speed with which the F-102A can become operational with squadrons just getting the new equipment.



ONE POSSIBLE type of trainer would be built around escape capsule with periscope for pilot's use from reclined position.

Combustion Is Focus of Rocket Meeting

By Robert Cushman

Buffalo, N. Y.—The American Rocket Society's National Fall Meeting here was largely devoted to getting down to business on scientific and engineering details of rocket and ramjet fuels and the combustion and heating problems that will follow the solution of these propulsion problems.

By its choice of papers, the society emphasized that present fuel and combustion knowledge is inadequate for best design of high performance rockets. But scientific interest in these problems left the impression that reality may be near for what Leston P. Faneuf, president of Bell Aircraft Corp., predicted as a "brand new U. S. industry, as vigorous and essential to peacetime America as dishwashers and automobiles."

Combustion subjects covered:

• **Correlation of prediction** methods with actual performance of new fuels and combinations. John B. Fenn, Princeton University, and Hartwell F. Calcote, Experiment, Inc., Richmond, Va., described some of their work on a Bumblebee project contract. They found that minimum spark ignition energy is the only property which predicts the loss of specific impulse at altitude.

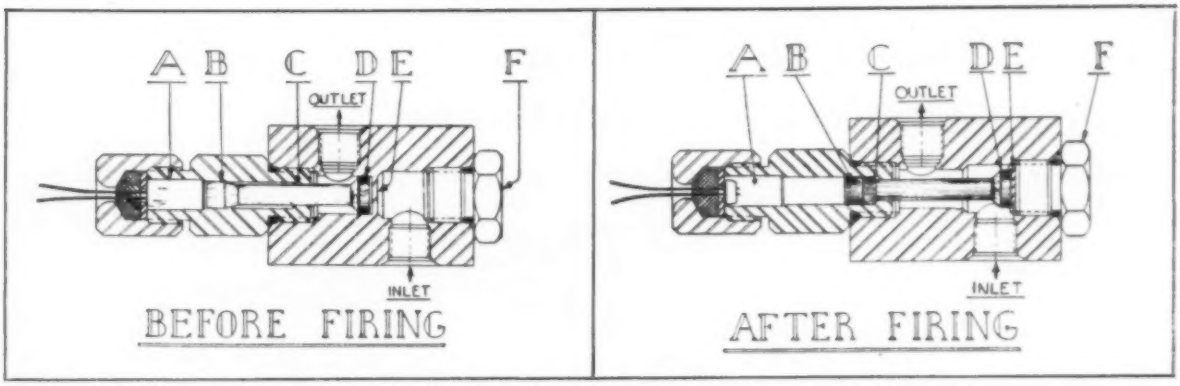
• **Scaling of combustion** systems so that results on small scale laboratory tests could be related to large engines and performance of new engines could be related to older engines of different sizes. Both Stewart Way of Westinghouse and Stanford S. Penner of California Institute of Technology presented papers summarizing and extending the knowledge in this difficult field.

• **Use of unsymmetrical** dimethyl hydrazine as a starting fluid for nitric acid-jet fuel rocket engines. Because the nitric acid-jet fuel combination is non-hypergolic (it won't light spontaneously), a third chemical which ought to be spontaneously inflammable with one of the two propellants is needed and unsymmetrical dimethyl hydrazine was described as attractive by Robert L. Potter and Harry W. Byington of Bell.

• **New way** of making a combustion system more compact. A new twist on variable geometry engines was the rotating flame stabilizer of John H. Grover, Michael G. Kesler and Arch C. Scurlock, Atlantic Research Corp., Alexandria, Va.

Flame fronts in combustors without and with the benefit of a rotating flame holder illustrate to what extent the combustor length may be shortened and yet achieve the same completeness of burning. Rotating rates of 15,000 rpm. were discussed. (Way also mentioned the possibility of variable geometry in combustors: he pointed out that it may be worthwhile to vary the amount of primary and secondary airflows according to altitude and flight speed.)

Next to combustion the ominous implications of the thermal thicket received the most attention as they apply to satellite launching rockets. Dr. J. Fredrich Vandrey, scientist-at-large reporting to the management of



EXPLOSIVE charge (A) drives ram (D) through solid wall (E) in new type valve to make passage for valve flow.

Glenn L. Martin, sketched in what he thought were the greatest possible temperatures for various altitudes and speeds.

For typical rocket trajectory, Dr. Vandrey's calculations indicate that whatever happens the nose cone temperatures won't exceed those shown in the lower graph, below. After 200,000 ft. the temperatures fall off despite increasing Mach number because of the increasingly rarified atmosphere. Since known metals will withstand these temperatures, building of such rockets is feasible, despite lack of knowledge of the exact nature of upper atmospheric phenomena such as slip flow and molecular dissociation.

However, Martin is using more elaborate methods to calculate the skin temperature for the Vanguard project, Dr. Vandrey told AVIATION WEEK.

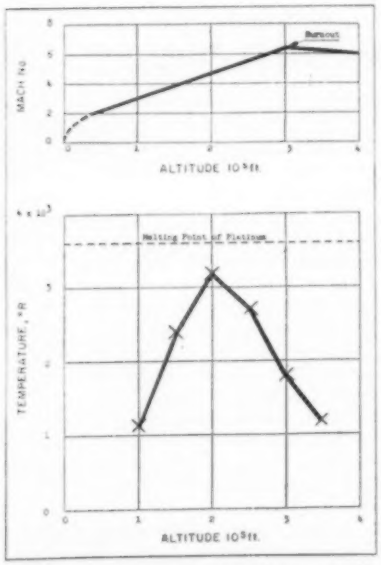
An example of the difficulties is in estimating just how much lower the actual temperature will be in case initial molecular dissociation would absorb energy and lower the temperature, he said. The unbalanced molecule could find its way to the rocket's surface and reoxidize to raise local temperature.

Cooling for interior surfaces of rocket motors and high speed missile nose cones by liquid films spread from holes in the metals was discussed by two groups of authors from Purdue University. The type of slot for cooling liquid injection and the fact that the amount of flow required for most rocket engines would form a well behaved wave and attached film was established by C. F. Warner and B. A. Reese. Superior qualities of water for the injection liquid as well as design hints on the proper injector configuration were given by M. J. Zucrow and A. R. Graham.

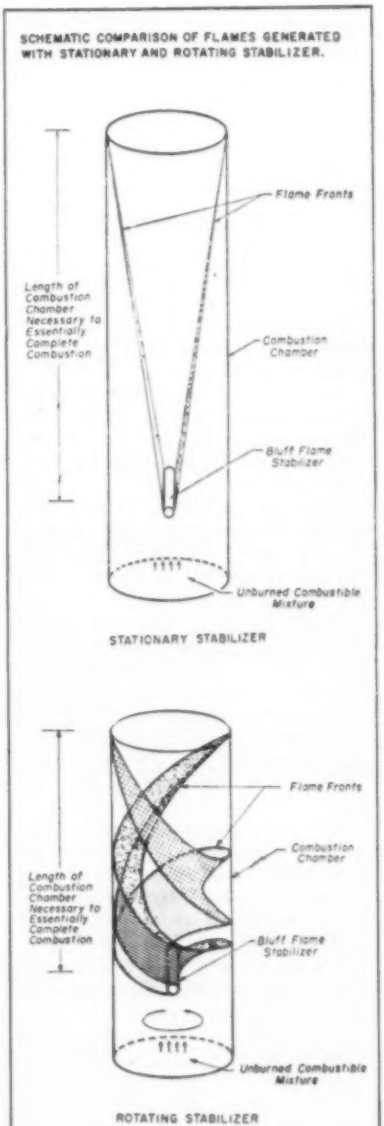
Only one author touched on the more general aspects of space (or at least very high altitude) travel. The approach of the U. S. Naval Training Device Center, Port Washington, N. Y. to pilot selection and training methods for high speed, high altitude rocket powered flight was outlined by J. N. Pecoraro, head of the center's Air Applications Branch. In addition to a flight simulator built around an escape capsule, Pecoraro said that other environmental trainers were necessary. They are: rocket acceleration trainer, decompression chamber, space disorientation trainer and global navigator trainer.

Among the devices on exhibit during the meeting was a compact, reliable explosive-type valve for missiles.

As diagram above shows, this normally closed version of the valve uses an explosive charge to drive a ram through a solid wall making a passage for the valve flow. Advantage is that this valve can operate against 9,000 psi. in .0002 seconds, yet be very reliable (99.960/0) on minimum currents and low in cost ($27 for ¼ in. diameter). Maurice W. Connell, president of the Cona Corp., Buffalo, which makes the valves, said they are now in use on the Terrier, Bullpup and Bomarc missiles.



NOSE cone temperature, altitude compared.


SCHEMATIC COMPARISON OF FLAMES GENERATED WITH STATIONARY AND ROTATING STABILIZER.
Flame Fronts
Length of Combustion Chamber Necessary to Essentially Complete Combustion
Combustion Chamber
Bluff Flame Stabilizer
Unburned Combustible Mixture
STATIONARY STABILIZER
Flame Fronts
Length of Combustion Chamber Necessary to Essentially Complete Combustion
Combustion Chamber
Bluff Flame Stabilizer
Unburned Combustible Mixture
ROTATING STABILIZER

ROTATING flame holder shows improved burning compared with stationary holder.

Everest Blames Slow Moving X-2 Project on Lack of Research Funds

Buffalo, N. Y.—Skimping on research funds made for a slow-moving X-2 program, Lt. Col. Frank K. Everest told the American Rocket Society. The 1,900 mph. record he set and the 126,000 ft. altitude record a successor attained could have been reached with proper funds, in his opinion, three to five years ago.

Using an informal sort of extrapolation, which he may not have meant literally, Everest told a news conference before his luncheon talk that man should now be flying 7,000 mph.

The X-2, Bell Aircraft Corp. engineers said, has reached its limits of speed and altitude.

Everest shrugged off the attempts to portray him as a brave young daredevil plunging intrepidly through the thermal thicket, and replied, "There's a lot of difference between passing your finger quickly through a match flame and holding it there." Since the X-2 had rocket power for only 2½ min., he left the impression that the X-2 exploration of aerodynamic heating had just begun.

Bell engineers, who also were at the meeting, seemed to feel that the X-2 was far from as advanced a design as they could produce. As an example, they said they might go to straight wings, as those of the F-104, though the X-2 faces its own peculiar problems in this respect. It must have sufficient wing area to carry the large amount of fuel necessary to accelerate from its slow launching speed.

Everest and Bell engineers added some details of the X-2 flights, including some of the control and stability problems encountered:

• **Ascent to test altitude.** Everest said he flew by Mach meter and altimeter. After a little experience (Everest made 13 X-2 flights totaling in all less than two hours flight time and most of it power-off glide), the pilot is able to judge and compensate for instrument lag at high values of acceleration and climb. As for darkening and sky color changes, he could judge after he became acclimated what the changes meant regarding his position.

• **High altitude flight.** Everest said leveling off at altitude was difficult because of the great missile-like inertia of the X-2 at those speeds and diminished air resistance which created a tendency to overshoot and the sluggishness of control response in the rarified atmosphere.

The record speed runs, made at 60,000-70,000 ft., did not have such pronounced sluggishness on controls. The X-2 did suffer from some control instability problems, Everest said, and he referred to stabilator control on one flight.

(Joseph Cannon, chief of flight test for Bell, said that one of the problems of high altitude flight was the danger of stall. If a stall ever occurred, he said, the pilot would be unable to gain any control effect in the thin air at low speeds and the plane would tumble, perhaps re-entering denser air tail first, imposing loads that would tear the plane apart.)

• **Descent and landing.** Everest found windshield fogging in descent not as bad in the X-2 as it was in the X-1. But there was troublesome fogging that occurred just about touchdown. Landing was a problem, and Everest said he skidded all over on three landings in the early stages of the tests. The nose wheel, rather than the skid, caused the trouble and a fix was made. Landing speed was 180-200 mph., and the plane was flown onto the ground rather than stalled in a conventional landing. Skidding around started at about 100 mph. as controls lost effectiveness.

On the outer end of the leading edge of the wing, the X-2 has a 15 deg. downward cant, a camber increasing device linked with the flaps to provide greater wing lift at lower speeds.

• **Escape capsule.** Everest said that he would have never used the ejection capsule except as a last resort because the separation forces appeared to be so severe. Ejection seats had not been developed when the X-2 was laid down, and to save time it was decided not to put one in afterward.

X-2 Destroyed

Edwards AFB, Calif.—The Bell X-2 high-speed rocket research plane was destroyed here late last week. The pilot, USAF Capt. Milburn G. Apt, was killed when the main parachute on his escape capsule failed to open.

Capt. Apt, on his check-out flight, had just reported burn-out of his rocket fuel and was gliding down from an altitude which Air Force described as "not excessive."

When the plane failed to come into sight or show up on radar tracking scopes, a search was begun. The Air Force said it assumes Capt. Apt ejected, but it did not immediately know why.

The drag chute on the escape capsule opened, but the larger chute did not. Capt. Apt was found dead inside the capsule, which fell on the Edwards range.

In recent weeks the X-2 had reached an unofficial record speed of 1,900 mph. and an unofficial record altitude of 126,000 ft., with other pilots at the controls.

The X-2 was to have been turned over to the National Advisory Committee for Aeronautics within the next month or so for studies on aerodynamic heating, stability and control.

No date had been set for the turnover, but it was to have come as soon as Air Force had completed maximum performance evaluation tests.

Studies were to be carried out at NACA's High-Speed Flight Station here. Emphasis was to be on heat inputs at high speeds and high altitudes, rather than structural effects of heating, and correlation of the findings with information obtained in laboratory and wind tunnel tests.

Single Stage Space Ship Suggested

By David A. Anderton

Rome—Man's first space ship could be a single-stage or at most a two-stage rocket; it might be ready for flight much sooner than current estimates of 25 to 50 years.

This startling contrast to current proposals of multimotored, multistage, multimillion pound rockets was suggested by Col. William Davis of the ARDC Office of Air Research at the Seventh Congress of the International Astronautical Federation.

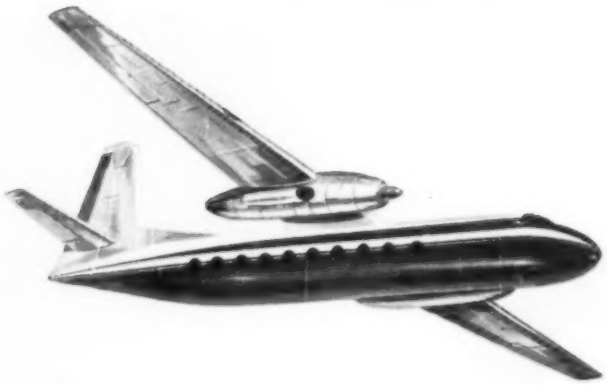
But to many delegates surfeited with visions of satellite supermarkets and grand tours of the nebulae Davis' plea for more creative thinking went over like the proverbial lead balloon. The vigorous discussions and debates turned over finer points of space law or the probability of reaching the limits of the universe in one crewman's lifespan.

Davis pointed out that too many of the schemes proposed for space flight are based on linear extrapolations of today's techniques.

The fallacy is that scientific progress never has been linear but has shown an exponential growth rate. Yet, in the face of historical precedent in almost any phase of science examined, the advocates of space flight still analyze chemical rockets, still consider limited powerplant advancement, still design high acceleration systems.

"It is not unreasonable," Davis said in his prepared paper which was the basis for his presentation, "to expect a propulsion system of new type to be invented in the fairly near future."

Such a system might be used to propel a single stage spaceship at constant low acceleration on the order of .01G.



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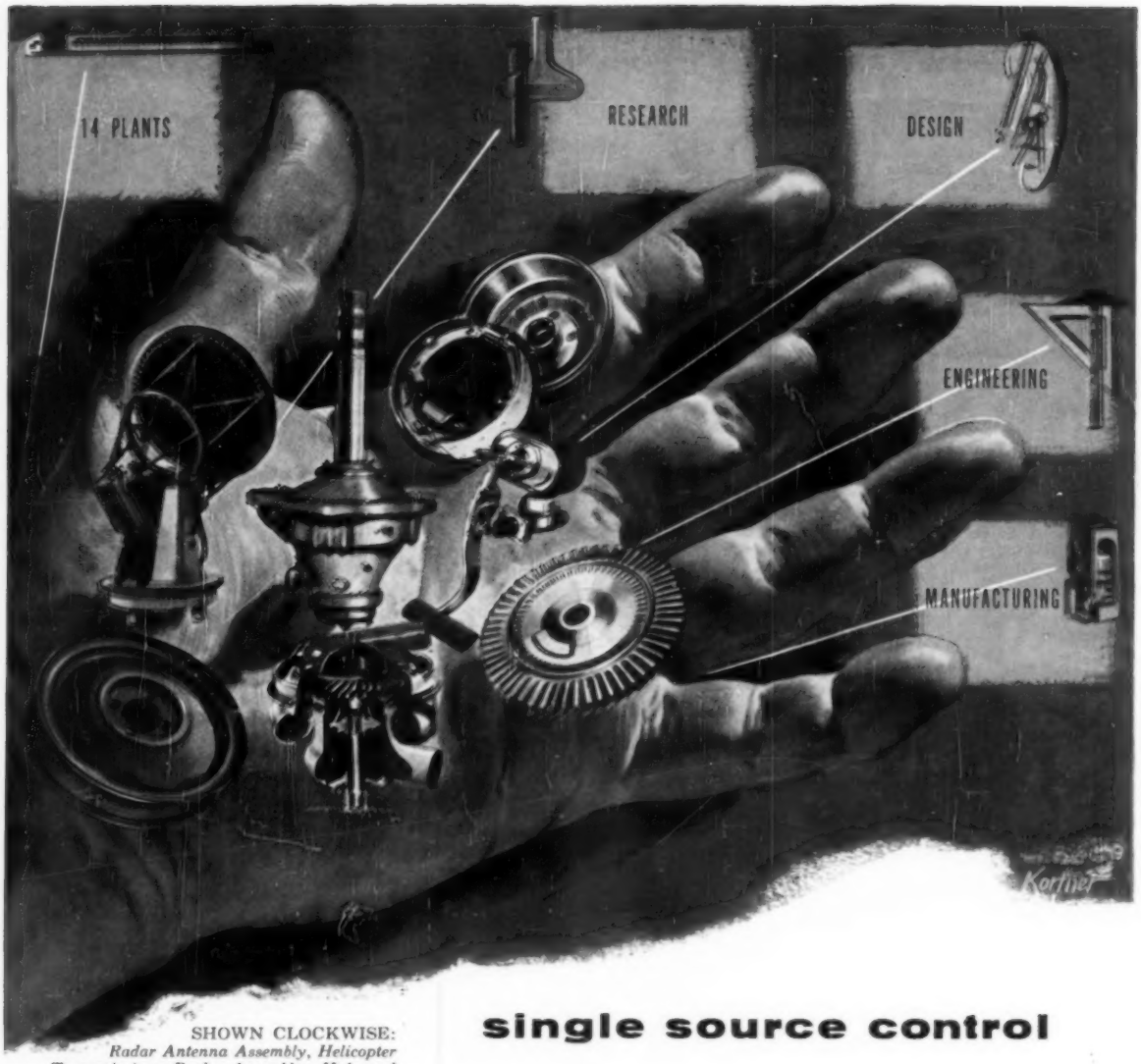

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• **Study of a permanent** satellite of the Moon proposed by Robert Buchheim of Rand Corp. A rocket booster system weighing on order of one million pounds would be needed to establish such a satellite in a retrograde orbit around the earth's Moon. But errors in guidance and control would have to be held to about one twentieth those hoped for in project Vanguard. Buchheim said the Moon satellite would be optically visible from the earth and would maintain a permanent orbit.

• **Possibility of life** on about 100,000 other planets in the universe was suggested by Dr. Hubertus Strughold of the USAF School of Aviation Medicine. Strughold described the ecosphere, a biological concept that defines possibility of life in planetary systems. For our own system such a zone extends from orbit of Venus out to beyond Mars. Using earlier estimates that 100 million out of a total number of stars 10^{20} have planetary families, Strughold considered the possibility of an ecosphere for about 100,000 of them. But he added that all of this is and probably must forever remain a matter of delightful speculation.

• **Possibility of space** travel to nebulae millions of light years distant was examined by Prof. Eugen Saenger. He reiterated what science fiction writers have been saying since they heard of Einstein: relativity shows that time expands at speeds near that of light. Thus the life process of a rocketship crew effectively slows. The favorite theme of the writers revoiced by Saenger has been that of a space ship returning to Earth centuries after a galactic run that seemed like only a few days to crew traveling on the expanded time scale.

Pratt & Whitney Aircraft Announces Promotions

East Hartford, Conn.—Pratt & Whitney Aircraft Division of United Aircraft Corp. last week announced three major promotions to meet its expanding operations in Connecticut and at its new Florida engine facility now under construction (AW Sept. 10, p. 34). They were:

• **Leonard C. Mallet,** 51, assistant general manager, has been named general manager for Connecticut operations.

• **Charles Roelke,** 38, executive assistant to the general manager, has been appointed general manager, Florida.

• **Newton V. Turney,** 46, former controller of Chance Vought Aircraft, has been appointed divisional controller for Pratt & Whitney's Florida operations.

Wright A. Parkins has relinquished his post as general manager for all Pratt & Whitney operations, effective Oct. 1, but will continue as a vice president.

B-52s Fly Again

Washington—The Air Force last week permitted the ungrounding of its Boeing B-52 intercontinental jet bombers after a rigid inspection of all "internal systems." The big aircraft were ordered out of the air following a fire and crash in California that claimed the lives of five crew members (AW Sept. 24, p. 30).

There was no indication of what caused the accident near Castle AFB, Calif., or what flaws were being looked for in the new inspection order. A USAF spokesman said investigation of the accident is being continued.

Missile Range to Get Data Collection Ships

Baltimore—Contracts for demothballing and instrumentation of several small government cargo freighters to be used as data collecting stations on the Air Force Missile Test Range off the Florida coast were announced by Air Research and Development Command.

The 5,000-mi. range stretches from Cape Canaveral at the Air Force Missile Test Center in Florida to Ascension Island in the South Atlantic. The ships will be used in the last 3,000-mi. span from St. Lucia to Ascension, where no islands are available for range stations (AW Aug. 6, p. 110).

Following negotiations with Pan American Airways Guided Missiles Division, which operates the range for ARDC, the major contract for ship modification was awarded to Moore Drydock Co., of Oakland, Calif. Moore will demothball, dehumidify, soundproof and make minor alterations. The number of ships to be used has not yet been decided.

Ralph M. Parsons Co., of Pasadena, Calif., will assemble and install electronic equipment. Modifications were designed and planned by Michael J. Ryan and Associates, San Francisco naval architects.

LaGuardia Approach Capacity Increases

New York—LaGuardia airport's capacity to handle instrument traffic by means of radar controlled approaches will be increased by 50% under new procedures effective Oct. 1. They were established by Civil Aeronautics Administration as the first phase of a program to improve traffic control in the New York area (AW Aug. 27, p. 40).

New York International Airport traffic also will benefit immediately from the new procedures, made possible by commissioning of ASR-3 tower radar at the two fields, along with establishment of a new eastbound airways from Pennsylvania and new offset holding patterns.

ASR-3 will become operative at Newark about Nov. 1 and the acceptance rate at that airport will rise. The changes, plus full use of new long-range radar at the New York en route control center when manpower conditions permit will increase the area's instrument landing capacity by 50% this winter CAA hopes.

Additional inbound airways will be added until four airways from the west and three from the south will channel traffic into the area. All but one of them will be installed within 30 days, according to CAA First Region, with the final installation next spring.

Controllers using radar in handling approaches now can allow separation of aircraft in terms of miles rather than minutes. New minimum will be 3 mi. separation, whereas the average separation previously was 3.2 min. or better than 10 mi.

The ASR-3 makes approach radar control possible because of its improved reliability and efficiency, CAA says. CAA estimates that about 45 instrument movements an hour will be possible at LaGuardia under the new procedures, compared with a present capacity of about 30.

The new holding patterns for LaGuardia have been established at the Newark and Idlewild ranges for approaches from the southwest (Runway 4), and at Meadowbrook intersection and Glen Cove radio beacon from the northeast (Runway 22). For each approach there now are two primary holding patterns, offset from either side of the final approach path. Aircraft are vectored directly from these patterns into their instrument approaches. Formerly the LaGuardia-bound planes were held in a primary pattern at Flatbush or New Rochelle or a secondary holding pattern, then cleared from the single primary pattern into their timed approach.

USAF Orders F-104s

The Air Force has awarded Lockheed Aircraft Corp. two letter contracts totalling $166 million for production of an undisclosed number of F-104A and F-104B Starfighters.

The $115 million contract for F-104As is the largest single contract awarded to Lockheed in its 13 years of continuous jet production. The contract for F-104B two-place tactical fighter-trainers totals $51 million. The contracts will extend deliveries through 1958.

Jet Transport Orders Set Airline Future

Lockheed, Convair, Douglas, Boeing compete for medium-haul market; more orders seen for pistons.

This month, one year from the date the airlines began their expensive and decisive turbine transport buying spree, some patterns have become clear. They draw a firmer picture of the future for both the airlines and manufacturers.

The pattern of equipment types bidding for airline favor has undergone a substantial change. Whereas a year ago it appeared that the DC-8 and the Boeing 707 would dominate the long routes and the turboprops would serve the shorter ones, now a new family of shorter-range turbojets is moving in to change the competitive picture.

And through their turbine orders, the airlines seem to be committing themselves to a split type of operation well into the 1960s. As the currently available turbine transports have stretched in range and size, nothing has come on the scene to replace the efficiency of the Super Constellation, DC-6/7 types for the shorter hauls.

As the patterns have developed for the airlines and the manufacturers, these points have become clear:

- **Piston-powered transports** will be an important part of the air transport picture for a long time to come, and another round of orders for piston transports is a good prospect.
- **New competitive pattern** has developed in the medium-range jet field with the Convair 880 now offering stiff competition to the Lockheed Electra, and the Douglas DC-9 and Boeing 727 projects developing as further competition for both the Electra and 880.
- **Markets for sales** of turbine-powered transports are still large. Manufacturers are accelerating their efforts to fill these markets, and the British are still a potent factor in the competition for turbine transport sales.

Competition Spurs Changes

The hard decisions through which the airlines moved into these patterns were precipitated a year ago this month when Pan American World Airways broke the floodgates with orders for a mixed fleet of 45 Boeing 707s and Douglas DC-8s.

American Airlines and Eastern Air Lines had started things moving with orders for the Lockheed Electra, and Capital Airlines already had its first Viscounts in service. But Pan American touched off the heavy buying.

By the end of the year, the airlines had $1 billion worth of turbine equipment on order. Most airline executives would have preferred to wait longer to make their decisions. But in the airline industry, when one orders, all must order to avoid being left behind in the race for a faster, more-novel product to sell.

In this initial surge, the 707 and the DC-8 stayed fairly close in the race for the long-range jet market. There was relatively little to choose between them as Boeing and Douglas modified their designs from week to week in an effort to satisfy their sales prospects.

For the shorter-range markets, it appeared that Lockheed's turboprop Electra would dominate the scene with American, Eastern, Braniff and National buying early places on the production line. This time element was, and remains, important since the Electra will be out a year ahead of the big turbojets and will have at least a two-year jump on other turbine transports in its field.

Gap in Equipment Pattern

Then last spring, Convair moved onto the scene with a medium-sized turbojet transport called the Skylark to challenge the Electra. By June, Howard Hughes had negotiated the Skylark into a flamboyant, golden-skinned transport called the Golden Arrow which he ordered for the use of Trans World Airlines.

Delta Air Lines also ordered the jet, whose name has been changed to the Convair 880.

Now, Douglas and Boeing are discussing small jets with the airlines. Although these transports—the DC-9 and 727—are not firm designs, they indicate the general confidence in a big future market for the smaller turbojets.

All the turbine transport designs grew larger as discussions with the airlines grew longer. Finally, in an effort to cover all operational possibilities, even the medium-range Electra and 880 were stretched to give them transcontinental capability.

This stretching increased the flexibility of the transports, but it also opened a gap in the equipment pattern. Between the 40-passenger Fairchild F-27 and 44-passenger Viscount and the 75-100 passenger Electra-880 class, no new turbine transport has appeared that will do the efficient, short-range job of an airplane like the DC-6B.

Flexibility is a virtue, but there is a definite need for a medium-sized transport in the airline pattern that has no need for transcontinental capability, much as the Convair and Martin twin-engine transports have done the short-haul job in the past.

Without a new transport in this under-1,000 mile range, it appears that the airlines will evolve a pattern in the 1960s in which the turboprops and turbojets will fly the longer, higher income routes, and present piston transports will work on short hauls.

If this pattern continues to develop, hopes of an all-turbine operation that will make money will remain just an airline dream well into the 1960s.

There is some deep thinking going on in airline offices right now on future piston-engine needs, and the chances are good for another round of orders for the latest piston transports. Indications of this can be seen in the recent, unadvertised moves of American and United to increase their orders for DC-7s.

More orders for piston transports will provide more of this type of capacity to supplement turbine operations in the 1960s. And more piston transports delivered in 1958 will be a hedge against delays in delivery of the first jet transports. Airline traffic is expected to continue to grow at its current healthy rate, and the carriers cannot take a chance on not having the capacity to handle the business.

Increasing Sales Effort

Meanwhile, the manufacturers are continuing efforts to sell their jets in the domestic market and are stepping up their sales efforts abroad. Convair has set up a special research department to work on airline orders, and other companies are making similar efforts.

The long-range jet market is still dominated by the DC-8 and 707. Both transports have more similarities than they have differences, and the major factor in airline decisions between them

This review of turbine powered transports and their markets was prepared by Transport Editor Craig Lewis from material gathered by Aviation Week transport editors in the Los Angeles, New York and Washington Bureaus.

has been the all-important delivery dates available.

Douglas decided to stick with a single basic airframe and modify it to suit the needs of the airlines. With various structural modifications and engine combinations, the DC-8 is available in four versions. For domestic service, a Pratt & Whitney J57-engined DC-8 will have a gross takeoff weight of 250,000 lb., and the more powerful Pratt & Whitney J75 engine will give the airplane a 265,000 lb. takeoff weight.

The intercontinental version can be ordered with either the J75 or the Rolls-Royce Conway engine. Either engine gives the DC-8 a 287,500 lb. takeoff weight.

DC-8 Flight Schedule

The DC-8 is scheduled for first flight in March 1958. Flight testing will be done with nine airplanes, and the certification deadline is October 1959, although Douglas is hoping that certification can be completed by August of that year. This schedule is for the J57 version; the J75-equipped DC-8 will be certificated a few months after the lighter airplane, and the Conway version after the J75.

Boeing is building two different-sized models of the 707 to satisfy its customers. The two Boeings straddle the DC-8 in operating specifications with the domestic 707 slightly smaller than the domestic DC-8 and the 707 Intercontinental slightly larger than the overseas version of the DC-8.

The Boeing 707-120, equipped with the J57, will have a maximum weight of 247,000 lb.; the 707-220 will have a weight of 258,000 lb. with the J75 engine. The larger 707 is the Model 320 Intercontinental with J75 engines. This version will have a maximum gross weight of 295,000 lb.

Existence of a flying 707 prototype has given Boeing an advantage over Douglas in its sales efforts. And the experimenting Boeing can do with the 707 in the next two years may make it easier for the airlines to put the production 707s into service. The first 707 is supposed to be ready to go into service with Pan American by the end of 1958.

Sales of the Convair 880 have remained at the original 40 ordered by Hughes and Delta, but several airlines are reportedly interested in the transport and the possibilities it offers for an all-turbojet operation. One of the 880's strong points is that an airline could have a fleet of medium-range and long-range jets without having to bother with two types of engines.

The 880 has grown some since it was first proposed, but it is still smaller than the DC-8 and 707. It is being sold as a medium-range jet built to operate at the smaller airport that cannot handle the DC-8 and 707. Power will be four General Electric CJ805 (J79) engines.

The transport will have transcontinental range and a maximum gross weight of 173,500 lb. It will carry 80 to 113 passengers, depending upon whether it is used for coach or first-class service. Convair plans to deliver the first 880 in November 1959, and to have it certificated by May 1960.

Convair claims that its 880 is superior to a turboprop transport because it is faster and can be operated as economically on the shorter routes. Convair also points out that the slower turboprops will become obsolete faster than the turbojets, which are as fast as they can get until air transportation goes supersonic.

Electra Fate

When the 880 moved into the medium-range market, speculation arose in aviation circles over the fate of the Electra. Lockheed remains firmly behind its Electra project, and, this week, with design work 80% complete, fabrication operations are scheduled to start.

Lockheed's sales pitch is based upon the philosophy that each airplane has its own mission, and that the turbojets can't touch the Electra for economical operation on short routes. The Electra is designed to cruise at 405 mph., with a potential top of 500 mph. when more powerful turboprops are developed. Its gross takeoff weight is 113,000 lb., and passenger capacity will range from 66 to 91, depending on configuration.

Probably the chief selling point for the Electra is that it will be in service in 1958—the first flight is scheduled for January 1958. This is the reason it had to have transcontinental range—the airlines getting the Electra in 1958 will want to use it on their blue ribbon, long-haul routes.

After the turbojets get fully into service, probably by 1962, the airlines plan to move the Electra over to serve the shorter routes. While it is difficult to make solid economic judgments from paper forecasts, the Electra probably will be cheaper than turbojets to operate on the shorter routes.

The British also have made a bid for the U. S. market and have had some success. In July, Capital Airlines bought 14 Comet IVs, and before that, Vickers-Armstrongs sold Capital 75 Viscounts. Since the Comet offers earlier deliveries than U. S.-built jets, de Havilland may still sell more of them here.

The Bristol Britannia looked like another good sales bet for U. S. airlines, but engine icing problems have delayed placing the big turboprop into service and drastically cut the delivery time advantage the Britannia enjoyed.

Battle of the Interiors

Continental Air Lines may possibly have found the answer to the missing short-medium range turbine transport with its order for 15 Viscount 810/840s. This stretched Viscount will handle up to 70 passengers, but should be cheaper to operate on short hauls than American turbine transports.

Smallest of the new turbine family now going into production is Fairchild's twin-turboprop F-27. Termed a DC-3 replacement, this 40 passenger, short-range aircraft is actually the next logical step in the development of short-haul

Turbine-Powered Transport Orders

Following is a month-by-month tabulation of U. S. and foreign airline orders for American-built turbine-powered transports beginning with an American Airlines order for 35 Lockheed Electras in June 1955:

	DC-8	707	880	Electra
June (1955)				35
July				
August				
September				40
October	51	23		
November	14	30		
December	35	23		9
January 1956	2			23
February	8	8		
March				12
April		4		9
May	4			
June			40	
July				
August		3		
September		7		
TOTAL ORDERS	114	98	40	128

Three Airlines Order Proximity Indicators

Three major airlines, United, American and Delta have placed fleetwide orders for Collins Radio's new proximity warning indicator and Capital is expected to follow suit shortly. Collins' airline and business aircraft orders now total nearly 750.

transports and can't really be compared with the DC-3.

With all these designs for the new turbine transports becoming final, the competition is moving into the interiors. Manufacturers and airlines are hiring prominent industrial designers to work out new patterns for interiors.

Signs of new approaches can be seen in the expensive interior mockup of the 707 built by Boeing to show off its new ideas. Another is the new interior specified by American for its Electras which will compartmentalize the airplane and give a combination of fixed and flexible seating. American thinks this new approach is important enough to accept a three-month delay in delivery of its Electras.

Future Markets

The future pattern of turbine transport service in this country has become clearer in the past year as the airlines have bought heavily. The market is not yet saturated, and, as holdouts among the carriers order, the pattern may change.

Most of the airlines already have cast their lot with either the DC-8 or the 707 for long-haul operation. Eastern and National will compete with DC-8s. TWA and American will use 707s to compete with United's DC-8. Braniff and Continental have chosen the 707 and Delta bought the DC-8.

On the shorter routes, Capital will fly the Comet; American, Eastern, Braniff, National and Western will use the Electra, and TWA and Delta will operate the 880.

Still undecided on jets are Northwest Airlines, which has long transcontinental and overseas routes, and Northeast Airlines, which suddenly needs long-range equipment for its new New York-Florida route. Western also has yet to make a decision on a turbojet.

United is still thinking over its decision on what medium-range jet to buy. United, and the others, can choose from among the Electra, the Comet, the 880, the DC-9 and the 727. Lockheed is working hard on this market, even on the carriers who are buying a small jet. Lockheed says it still considers TWA a prospect despite the airline's plans to use the 880.

U.S. Drops Foreign-Travel Tax; 'Buffer' Muddles Fare Structure

Washington—A new tax regulation exempting virtually all international travel from the federal transportation tax went into effect Oct. 1.

Under the new ruling, only international transportation undertaken in U. S. territories and in so-called buffer zones is subject to the 10% tax. Buffer zones are designated as those areas in Canada and Mexico within 225 mi.

The tax modification stems from a bill introduced early this year by Sen. George Smathers (D.-Fla.) to remove "unjust and discriminatory provisions of existing law against travel to the Caribbean, Central America, Mexico and Canada." Signed into law by President Eisenhower on July 25, the regulation is the latest in a series of slashes taken to cut the wartime 15% transportation tax enacted to cut travel.

Originally, the tax applied to all domestic and international travel, but, as an aid to dollar-short Europe, it was shaved down in 1947 to include only passage between the U. S. and any point in the Western Hemisphere north of the equator, west of the 30th Meridian and east of the International Dateline. The tax was cut from 15% to 10% in 1954.

How New Ruling Works

Under the new ruling, the taxable portion of an international ticket is reduced to that part of the trip which covers the distance from point of origin in the U. S. to the last scheduled stop in this country.

For example, passage from Chicago to Bermuda via New York is taxable on the Chicago-New York portion only. Previously, entire ticket was taxed.

Trips from Minneapolis to Edmonton, Canada, or from Brownsville, Texas, to Mexico City will be tax exempt since both U. S. cities are last points of embarkation from the U. S. and Edmonton and Mexico City are beyond the 225-mi. buffer zone.

Montreal is within the buffer zone, however, and passage from New York or any U. S. city is subject to tax.

The law requires a tax on any transportation purchased in the U. S. and originating in the U. S., or in one of the buffer zones, and ending in a buffer zone or the U. S. This means that a ticket bought in the U. S. for a trip from Vancouver to Windsor, Canada, is taxable. A tax would apply to a trip between the buffer zone cities of Nogales and Hermosillo in Mexico.

Tax on transportation purchased ouside the U. S. applies only to travel that begins and ends within the U. S.

However, travelers from New York or Miami to such West Indies ports as Havana, San Juan or Nassau no longer pay a transportation tax on their trips. And, as examples, they may fly tax free from Houston to San Salvador and Balboa or from New Orleans to Montego Bay, Kingston or Ciudad Trujillo.

Complicated Computation

It is on trips between the U. S. and its territories that tax computations become complicated and may cause some confusion behind the ticket counters.

In its original form, the law states, for example, that passage from San Francisco to Honolulu is tax free except for that portion traveled between the airport and the three-mile coastal limit.

This means that a total of 20 miles of the trip is taxable, resulting in a tax charge of 14 cents per passenger. Tax for first-class fares from Los Angeles to Honolulu will be 12 cents, and tax on coach fares will amount to nine cents.

On Sept. 10, the Air Transport Assn. recommended a revision of this and several other sections. In a letter to the Commissioner of Internal Revenue, the ATA suggested that Honolulu travel "be deemed to be outside of the U. S."

The ATA estimated that tax derived from West Coast-Honolulu transportation sales would amount to $28,000 annually. Because a standard fare of $168 applies to Honolulu passage from all gateways, ATA further proposed that, if a tax should be charged, it should be a uniform rate regardless of which of the four gateways is used—Seattle, Portland, San Francisco or Los Angeles.

The association also asked that a standard table of tax amounts be adopted as a guide to tax computations on trips from U. S. points to cities in the interior of the territories.

Tax on a flight from Seattle to Fairbanks, Alaska, for instance, will be figured on a mileage basis from Seattle to the continental border and from the point of entry into Alaska to Fairbanks. That portion of travel performed outside the U. S. and outside Alaska will not be subject to tax as it was under the previous law.

Mileage pro-rate will be required to determine tax.

The airlines want a tax table to preclude errors or delays. Such a table is almost a requisite for travel agents and airline ticket agents.

On flights outside the Western Hemisphere, tax is chargeable only between the U. S. point of origin and the last scheduled U. S. stop.

More Pay for Most Controllers Promised in Civil Service Ruling

By L. L. Doty

Washington—The Civil Service Commission last week approved a new grade structure for air traffic controllers that will mean a pay boost for most personnel. However, it does not entirely eliminate the chance of downgrading.

Those facing possible pay cuts are controllers and assistant controllers in towers classified as "low activity" centers. The Civil Service Commission, however, probably will agree to the two-year moratorium proposed by the Civil Aeronautics Administration to permit transfers and reassignment from these centers. New personnel will be assigned to the low-activity towers to replace experienced controllers.

In all other categories of control towers and air-route traffic control centers, personnel will either receive a pay raise or remain at present pay standards. December has been set as the tentative effective date of the revised scale.

The decision climaxes a long struggle by the CAA with strong support from the Air Transport Assn. and the Air Traffic Control Assn. for an upgrade in pay to halt the exodus of personnel to better paying jobs in private industry (AW Aug. 27, p. 30).

The revised ruling falls one grade short in each classification of the standards requested by the Air Traffic Control Assn. However, ATCA President Clifton Burton admits that the new standards will have a favorable effect upon controller morale.

"It is not the best solution," Burton said, "but a little progress at a time is, on the whole, a good thing." He added that both the ARTC and CAA are looking for still another reappraisal of the grade structure in the hope of reaching a completely satisfactory settlement.

Under the new standards, chiefs in high density centers will be upgraded from GS-12 to GS-13 which carries an entrance salary of $8,990 a year. Most controllers will stay at GS-10, or a minimum of $5,915 a year, although some may be upgraded to a $6,390 minimum. Assistant controllers will move up one notch to a minimum of $4,970 a year.

All other air-route traffic control center personnel will remain at the same pay level except assistant controllers, who will be raised one grade to $4,970.

Centers will be divided into only two categories—high and low density. High-density centers, of which there are nine, will be those having peak-day IFR departures of 500 or more.

Air traffic control towers will be divided into three groupings—high activity, medium activity and low activity. In a high-activity tower, each controller must handle an average of 7,500 operations, including 200 or more instrument approaches, annually.

Chiefs of high-activity towers will be raised one grade to $8,990 a year. Watch supervisors are boosted to $7,570, controllers to $6,390, while assistant controllers are raised two grades to a $5,440 minimum.

In medium-activity towers, assistant controllers will be raised one grade to $4,970, with controllers and chiefs remaining at the present levels of $5,915 and $7,570 respectively.

It is in the low activity approach control towers that some downgrading will result. Chiefs will remain at the current rate of $6,390, and assistant controllers will be held at their present annual rate of $4,525. Regular controllers, however, face a pay reduction from their present $5,915 to $5,440 unless they accept a transfer to medium or high activity tower.

Primary purpose behind the classification of towers and centers is the provision of an incentive for holding controllers in busy, heavy traffic areas. Originally, the Civil Service Commission wanted to create an incentive differential by downgrading low-activity centers and towers without upgrading busier areas.

After protests by the CAA and ATA and constant prodding by the ARTC, the commission relaxed its stand.

New Nonstop Service For St. Louis Proposed

Washington—New nonstop competition for Trans World Airlines on its New York-St. Louis route should be provided by American Airlines and Eastern Air Lines, according to Civil Aeronautics Board Examiner Walter W. Bryan.

Reporting on the Eastern Route Consolidation Case, Bryan recommended that both Eastern and American be allowed to operate new non-stop services between New York and St. Louis and that operating restrictions on TWA and American be lifted.

Bryan recommended that American's Route 25 from New York be extended beyond Cincinnati to St. Louis with nonstop rights. This new authority also would allow American to operate a competitive transcontinental service through St. Louis, since the new route would connect with present American flights between St. Louis and the West Coast.

Eastern should be given its nonstop authority, according to Bryan, by consolidating Route 47 with the portion of Route 5 north of Washington. Along with the St. Louis-New York nonstop, this authority would provide direct service between such northeastern points as Boston, New York and Philadelphia and Charleston, Lexington, Louisville and St. Louis.

Bryan favors improving Cincinnati-Washington service by eliminating a restriction on TWA that requires Cincinnati and Washington flights to serve also Columbus or Dayton.

The examiner also would improve Louisville-Washington service by removing an American restriction that requires flights between Louisville and Washington to stop at Cincinnati.

Lake Central Employes Win in Federal Court

Washington—Lake Central Airline's employe-owners won a round in their battle to keep their airline when a Federal District Court held that North Central Airline's contract to purchase Lake Central is no longer valid.

Judge William E. Steckler ruled that North Central breached its purchase contract and that Lake Central does not have to sell its stock to North Central.

The decision will be appealed by North Central. The carrier said it was based on a misinterpretation of the law as it applied to the purchase contract.

Lake Central said it will ask the Civil Aeronautics Board for immediate disposition of the acquisition case covering the controversial merger. Last July, a CAB examiner recommended that North Central be allowed to take control of LCA and absorb its routes and equipment.

The case started in 1952 when North Central signed an agreement with LCA's majority stockholders for purchase of 96% of the carrier's stock. While the case was going through a series of legal maneuvers, a group of Lake Central employes concluded a deal in 1954 by which the majority stockholders sold them their stock.

The employes bought the stock subject to North Central's prior rights, but they have opposed the merger in the CAB case, and in May 1955, they asked the Federal District Court to void the North Central purchase contract.

Now the court has supported the LCA employes and ruled that North Central breached the contract by applying for LCA's routes and by delaying the acquisition case.

Napier Demonstrates Convair-Eland

Airline executives at the IATA general meeting at Edinburgh were flown in this Convair 340 bought by D. Napier & Son Ltd. for installation of Eland turboprop engines. Bristol Britannia 300 also was used for demonstration in an unprecedented sales effort by British (AW Sept. 24, p. 47). Napier, describing advantages of change to 3,200-eshp. Eland, said the Convair can carry its maximum payload of 12,900 lb. for 1,220 mi. instead of 290 mi. in piston-engine version and with an increase of 50 mph. in block speed.

IATA Meeting Ends With Election; Delegates Favor Control Authority

By Robert Hotz

Edinburgh—Tomas Delgado, president of the Spanish airline, Iberia, was named president elect of the International Air Transport Assn. at the final session of the twelfth annual general meeting last week. Delgado will assume the office of the thirteenth annual general meeting in Madrid next fall.

IATA delegates reacted with strong approval to the technical committee report (AW Sept. 24, p. 39) calling for creation of a central European traffic control authority to replace present national authorities operating within purely political boundaries. Proposal for central European traffic control authority came after the technical committee denounced use of political boundaries for traffic control purposes and urged a new concept of large area control to replace present system. Proposal for central European traffic control authority operating much like the U. S. Civil Aeronautics Administration also called for joint military-civil participation in the new system.

Positive Traffic Control

Although not specifically mentioned in the new proposal, tenor of earlier IATA discussions indicated the new authority would move toward establishing a positive traffic control system. Next move in implementing IATA's proposal is for heads of individual European airlines to approach their local governments on participation in the plan.

Not clear from current IATA discussions was how far east the proposed European air traffic control authority would operate, but presumably it would include Czechoslovakia, Poland and Yugoslavia, all of whom are IATA members.

Authority Power

In describing the proposal, Anselme Verniewe of Sabena, IATA technical committee chairman said the new authority should be empowered to purchase, locate and operate all ground navigation and air traffic control equipment. He also emphasized that a major start in such system could be made immediately by integrating military radar now operating in Europe with civil airways traffic similar to U.S. Rapcom system.

Problem of integrating military instrument flying with civil airline traffic in Europe is particularly acute. Airlines also complain bitterly of the practice of some military fighters using transports for practice interceptions and making extremely close passes.

Capt. J. W. G. James, chief of flight operations for British European Airways and vice chairman of the IATA technical committee said Britain already is working on integrated civil-military traffic control authority and would back European central authority plan.

Sud-Est Plans New York Office to Sell Caravelle

Sales of the twin-jet Caravelle will be the chief concern of a new office Sud-Est Aviation is now setting up in New York City. According to Sud-Est's general representative for North America, Claude J. Teyssier, the French firm hopes to convince American medium-haul operators that a two-engine turbojet makes as much economic sense as a two-engine piston transport.

The New York office will provide Sud-Est with closer contact with such firms as Sikorsky Aircraft, whose helicopters are manufactured by the French company under license. The Caravelle will sell for about $2 million, Teyssier said. To date Air France has ordered 12 of the jetliners, with priority for a possible 12 more, and orders for six Caravelles are under negotiation with two French governmental agencies.

SHORTLINES

▶ **British Overseas Airways Corp.** will move its Detroit operations from Willow Run Airport to Wayne Major Airfield on Nov. 7. At the same time, BOAC will begin its winter schedule to London with a Chicago-Detroit-

Montreal-Glasgow-London routing, and the current twice-weekly tourist flights will be replaced with a weekly mixed-class service.

▶ **Capital Airlines** has introduced new Viscount service to southern cities with the inauguration of daily flights to Raleigh, Durham, Charlotte and Winston-Salem, N. C.; Chattanooga, Tenn. and Huntsville, Ala.

▶ **Eastern Air Lines** is looking for 2,000 pilots and mechanics to meet requirements of the airline's fleet expansion this year and next. Eastern says it needs 400 mechanics, 100 pilots this year, 1,200 mechanics and 300 pilots in 1957.

▶ **Japan Air Lines ordered** a $1 million DC-6B flight simulator from Curtiss-Wright Corp.'s Electronics Div.

▶ **L. B. Smith Aircraft Corp.** of Miami has delivered CW20-T transports to Northeast Airlines, Aerovias "Q," Lloyd Aereo Colombiano and World-Wide Airways of Montreal. The CW20-T is a C-46 conversion designed by Smith to meet CAA transport category requirements.

▶ **Los Angeles Airways** completed 50,000 hours of flight operation last month.

▶ **Lufthansa German Airlines** starts new service from Frankfurt and Hamburg to Hanover and from Frankfurt to Nuremburg on Oct. 7. Daily flights between the German cities are scheduled to connect with transatlantic flights at Frankfurt.

▶ **Mackey Airlines** plans to begin its "tropical triangle" service on Nov. 9 between Florida, Nassau and Havana. Mackey's new DC-4 service will allow tourists to fly between Nassau and Havanna for the first time without having to travel via Florida.

▶ **Northwest Airlines** has asked the Civil Aeronautics Board to add Baltimore to its transcontinental route as a co-terminal with Washington, D. C.

▶ **Resort Airlines'** military contract revenues were $561,345 in August, a 30% increase over August 1955, revenues. Resort made a profit of $630,781 on revenues of $2,882,975 in the first half of the year.

▶ **Sabena Belgian World Airlines** will introduce service to Vienna, Warsaw and Budapest when its winter schedules go into effect on Nov. 1. The Belgian carrier will replace its S-55 helicopters with new S-58s this fall; DC-7C equipment will be put in service on routes to New York and Johannesburg in January.

AIRLINE OBSERVER

▶ Passenger-miles for domestic airlines operations in August are expected to show an increase of between 15 and 17% over August 1955. General dip in July load factors and the relatively low 6.8% rise in passenger-miles in July over the same period for 1955 are attributed to the TWA-United Air Lines accident over Grand Canyon, the steel strike, abnormal weather conditions and the mid-week Independence Day holiday. Impact of the accident on the traveling public is believed to have spent itself, and airline officials are now generally optimistic over third quarter prospects.

▶ **First flight of Lockheed Electra is scheduled for January 1958, with the certification date set for October of that year. Delivery to American Airlines, first in line for the turboprop transport, may be delayed because of interior changes, particularly in seating arrangement.**

▶ Australia's Qantas Empire Airways chose the Boeing 707 over the Comet IV jet transport because of the Boeing's greater range and speed. Qantas is no longer considering the Comet even for its South African routes.

▶ **F-27 turboprop transport options held by local-service airlines are considered firm by Fairchild but are carried as options because of the airlines' inability to lay down too much money at one time. Fokker-Fairchild combination has firm orders for 57 Friendships and options for 46 more. Fairchild has 31 orders and 29 options.**

▶ Capital Airlines is negotiating the sale of its entire fleet of 12 Lockheed 1049s to a foreign organization. Capital is in a position to take advantage of overseas markets whose payments would be in sterling since notes on its Viscounts are payable in pounds. It hopes to complete the sale within twelve months.

▶ **Swissair is making a strong bid to book nationals of such Iron Curtain countries as Poland, Czechoslovakia and Rumania now living in the West—for visits to their homelands. The airline foresees a good-sized market among these groups who previously were prevented from such trips by their inability to get visas or by fear of retaliatory measures.**

▶ El-Al Israel Airlines, unable to obtain financial aid from the Israeli government to offset mounting losses, may be forced to turn to foreign investors for capital. Among the more drastic measures suggested as a means of putting the company on a profitable basis is the discontinuance of transatlantic operations and concentration on Vickers Viscount service to Europe. Observers close to the situation admit that elimination of the transatlantic route would reduce expenditures by 50%. They add, however, that it also would result in a two-thirds loss income.

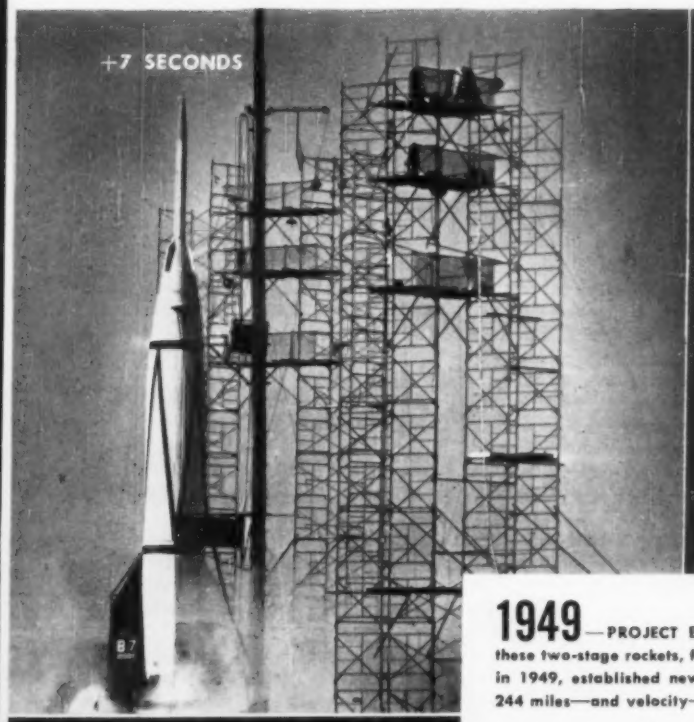
▶ **Aeroflot is scheduled to begin passenger service today with its Tu-104 jet transport between Prague and Peiping via Moscow and the Siberian cities of Omsk and Irutsk. Flights are scheduled to cover the 9,000-mi. route in 13½ hr.**

▶ Air Transport Assn. will study ground handling problems associated with noise and exhaust temperature and fumes from turboprop and turbojet transports during Oct. 8 meeting of ATA's Ground Equipment and Maintenance Facilities Subcommittee in Miami Beach, Fla. Emphasis will be on mobile ramp equipment and building requirements needed to insure passenger comfort and safe working conditions.

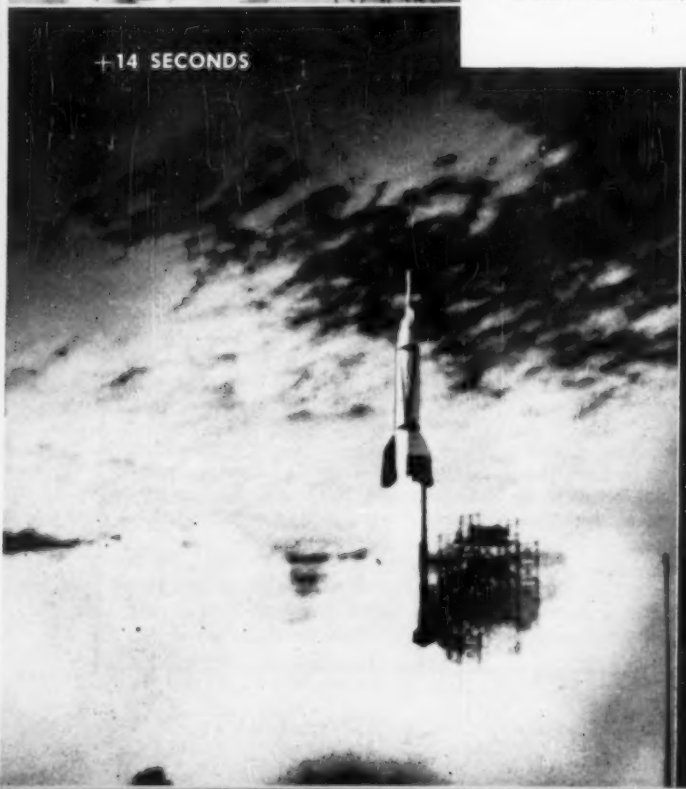
▶ **Southern Pacific Railroad ticket offices will provide flight information, make air reservations and sell airline tickets for United Air Lines as a result of a recent agreement between the two companies, the first such agreement in the U. S. between an airline and railroad. The agreement is scheduled to go into effect today.**

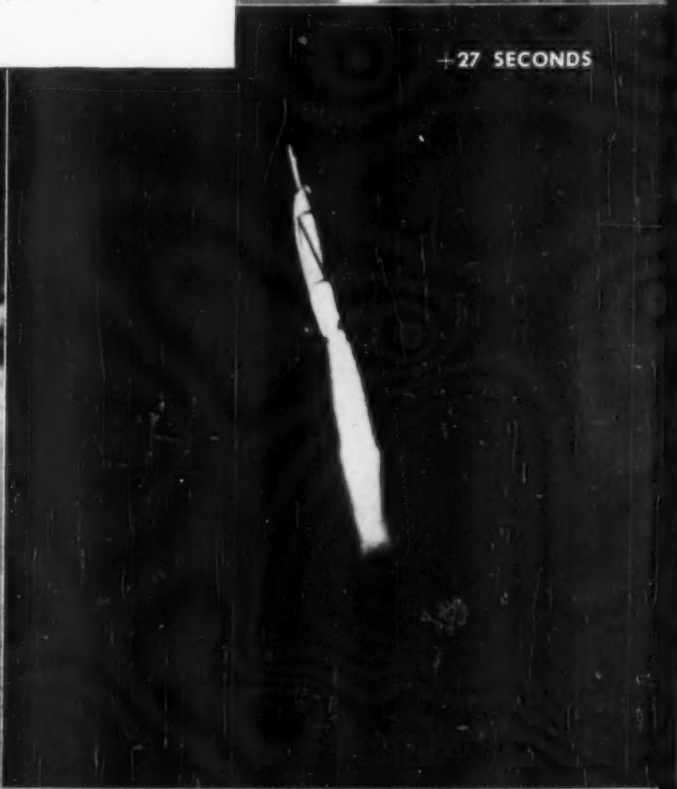
▶ Canadian lawyers are studying the possibility of writing provisions into Canadian law that would protect aircraft and airport operators from injunctions filed by residents near airports against jet aircraft noise.

How General Electric Experience



1949—PROJECT BUMPER—The fifth of these two-stage rockets, fired by General Electric in 1949, established new records of altitude—244 miles—and velocity—5150 mph.





Advances Missile Technology

General Electric's Project Bumper established new records of altitude and velocity. But far more important is the valuable research data compiled in the successful completion of the Bumper project. Many problems were overcome with Bumper—problems in temperature, telemetry, separation, and aerodynamics. Bumper helped solve the problems of communicating with missiles at extreme altitudes, and was a major preliminary step in the development of a satellite. In solving these and other problems, General Electric has contributed a wealth of research data to the missile industry—information that is being utilized on the nation's top priority ballistic missile project.

General Electric's Special Defense Projects Department presently is working on an Air Force prime contract to develop the ICBM nose cone. Programs are being carried out in such varied fields as communications, hypersonics, metallurgy, mathematics, and thermodynamics to support this nose cone contract.

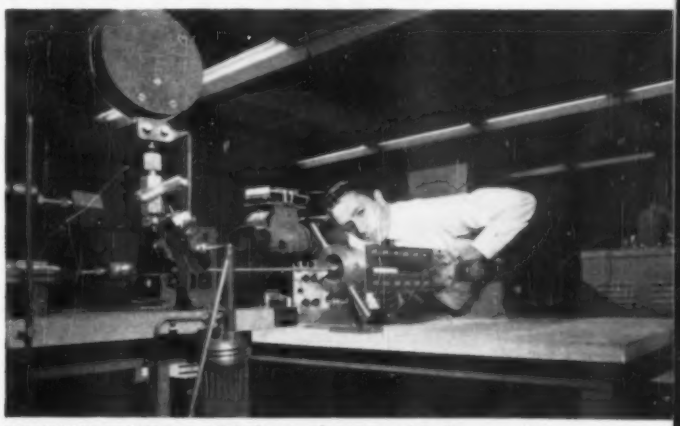
General Electric has formed the Special Defense Projects Department to act as a Company focal point for large, highly complex missile projects. Scientists in the new department, backed up by the vast resources of many General Electric operating departments and laboratories, are currently working to solve the perplexing problems associated with the ICBM nose cone and other missile projects.

By focusing this wide range of specialized talents of General Electric personnel on highly complex defense system problems, the Special Defense Projects Department is making significant contributions to America's defense program. Section 224-5, General Electric Co., Schenectady 5, N. Y.

ENGINEERS: G.E.'s Special Defense Projects Department is currently expanding its staff of highly skilled engineers and scientists. If you have a background of successful creative engineering, send your qualifications to: Mr. George Metcalf, General Manager, Special Defense Projects Department, General Electric Co., 3198 Chestnut St., Philadelphia, Pa.

TODAY—**CONTINUED RESEARCH AND EXPERIMENTATION** in advanced missiles and missile systems is helping solve such advanced problems as development of the ICBM nose cone. Headquarters for General Electric's participation in these programs is the Special Defense Projects Department in Philadelphia, Pa.

MR. ROBERT P. HAVILAND, Flight Test Engineer at SDPD, directed Project Bumper and other advanced programs, gaining valuable experience which he is currently applying to present missile programs.



DR. YUSUF A. YOLER—widely known for research in hypersonics—is currently engaged in the design and development of wind tunnels, shock tunnels, mass accelerators, and other facilities for continued progress in missile systems.

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Airline Income and Expenses—July 1956

(Dollar Amounts)

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Income	Total Operating Expenses	Net Operating Income (before taxes)
DOMESTIC TRUNK								
American	$22,011,254	$511,315	$233,140	$1,136,876	.....	$24,234,914	$21,194,100	$3,040,814
Braniff	3,174,893	90,271	41,776	95,770	.....	3,456,632	3,475,080	−18,447
Capital	4,733,575	93,984	49,879	79,990	.....	5,022,985	5,892,832	−869,847
Continental	1,327,342	34,710	10,336	34,200	$85,693	1,531,770	1,460,848	70,922
Delta	4,665,401	112,340	73,062	141,586	.....	5,091,295	4,863,404	227,891
Eastern	14,658,650	309,507	125,307	206,665	.....	15,617,254	16,101,427	−484,163
National	3,598,998	68,402	15,493	97,099	.....	3,995,697	3,426,634	569,063
Northeast	964,268	9,030	7,468	19,397	100,282	1,117,155	1,011,629	105,526
Northwest	4,206,402	128,180	74,771	168,883	.....	4,635,457	4,225,552	409,904
Trans World	13,800,002	327,070	224,899	352,362	.....	14,917,790	15,447,193	−529,403
United	20,176,035	642,479	309,869	838,934	.....	22,109,438	19,565,731	2,543,707
Western	2,844,719	74,131	29,691	43,028	.....	3,023,962	2,592,516	431,445
INTERNATIONAL								
American	449,787	12,995	358	65,468	.....	548,595	446,469	102,126
Braniff	490,717	116,318	.....	44,986	.....	681,914	540,095	141,818
Caribbean Atlantic	124,972	1,393	.....	3,447	.....	139,897	110,482	29,415
Delta	405,856	4,592	.....	10,460	.....	436,793	377,721	59,072
Eastern	1,589,453	16,806	.....	16,093	.....	1,719,515	1,143,392	495,145
National	324,225	3,339	1,158	7,342	.....	345,041	340,259	4,772
Northwest	1,445,522	438,465	5,064	286,617	.....	2,294,768	1,987,999	306,768
Pan American								
Alaska	506,000	19,000	.....	103,000	114,000	761,000	677,000	84,000
Atlantic	10,529,000	750,000	.....	640,000	192,000	12,527,000	10,020,000	2,507,000
Pacific	4,833,000	589,000	.....	528,000	95,000	6,324,000	5,454,000	870,000
Latin American	6,352,000	159,000	.....	841,000	529,000	8,276,000	7,203,000	1,073,000
Panagra	1,255,457	81,568	.....	102,932	.....	1,662,905	1,493,227	169,677
Trans World	6,092,464	508,122	.....	311,945	.....	7,212,098	6,380,292	831,806
United	1,531,231	29,835	.....	14,478	.....	1,589,416	1,028,209	561,207
LOCAL SERVICE								
Allegheny	408,244	4,362	8,734	4,301	142,947	577,440	627,791	−50,351
Bonanza	134,578	2,779	1,844	3,891	105,642	253,062	245,754	7,308
Central	93,957	3,205	773	3,047	175,483	278,861	272,123	6,738
Frontier	259,798	219,898	3,418	22,044	.....	515,957	491,711	24,245
Lake Central	103,746	2,643	4,058	.....	115,145	225,933	230,507	−4,573
Mohawk	327,851	4,005	3,000	5,576	53,408	417,916	499,454	−81,538
North Central	594,551	17,118	8,512	.....	95,990	735,214	712,439	22,775
Ozark	256,605	193,935	5,915	5,772	.....	467,580	534,102	−66,522
Piedmont	430,022	8,527	5,769	4,592	386,561	853,192	674,957	178,235
Southern	161,968	6,938	5,204	.....	140,704	323,353	338,974	−15,620
Southwest*	.....	.....	.....	.....	.....	.....	.....	.....
Trans Texas	255,030	9,161	4,044	10,249	203,294	485,537	513,542	−28,005
West Coast	181,342	3,434	1,411	3,385	146,813	344,264	318,589	25,674
HAWAIIAN								
Hawaiian*	.....	.....	.....	.....	.....	.....	.....	.....
Trans Pacific	216,897	576	.....	8,700	4,510	235,773	210,550	25,222
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	186,191	.....	190,754	186,425	4,329
Flying Tiger*	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	1,664,438	.....	1,664,438	1,628,220	36,217
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western*	.....	.....	.....	.....	.....	.....	.....	.....
HELICOPTER								
New York Airways	25,525	2,248	1,598	2,467	109,909	146,458	148,880	−2,421
Los Angeles Airways	10,228	9,832	5,992	.....	59,173	85,768	91,245	−5,477
Helicopter Air Service	.....	43,713	.....	.....	.....	45,257	42,231	3,026
ALASKAN								
Alaska Airlines	167,080	39,701	1,002	84,396	99,895	583,652	494,782	88,870
Alaska Coast	80,306	6,692	9,314	.....	34,350	149,550	115,507	34,042
Cordova	17,133	24,303	.....	8,199	.....	158,830	128,286	30,543
Ellis Air Lines	62,741	5,815	.....	5,747	21,461	116,131	87,509	28,622
Northern Consolidated*	.....	.....	.....	.....	.....	.....	.....	.....
Pacific Northern	646,651	208,304	.....	81,758	.....	967,750	782,760	184,990
Reeve Aleutian	48,497	18,154	.....	14,025	.....	112,260	82,089	30,171
Wien Alaska	113,044	49,893	.....	31,631	26,971	665,550	628,079	38,127

*Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Everett H. Brown, Superintendent of Aircraft Radio Equipment, American Airlines

Says:

AMERICAN AIRLINES

"Many G-E 5-Star Tubes have given us 6000 to 8000 hours' service. American relies on them!"

"As one of the world's largest airlines, American has to install electronic tubes with *proved* dependability. Flying-schedule maintenance, safety, and upkeep costs, all are affected by the reliability of our communications and navigation equipment.

"The fact that General Electric 5-Star Tubes meet this reliability requirement, counted heavily in our decision to include them among those tubes satisfactory for use in critical sockets.

"Our records show that General Electric 5-Star Tubes are long-life . . . many have served 6000 to 8000 hours. Failure rate is low. And the tubes are widely interchangeable between different makes of equipment, which keeps down our tube-replacement inventory. This is an important saving to American Airlines, with our large fleet!"

* * *

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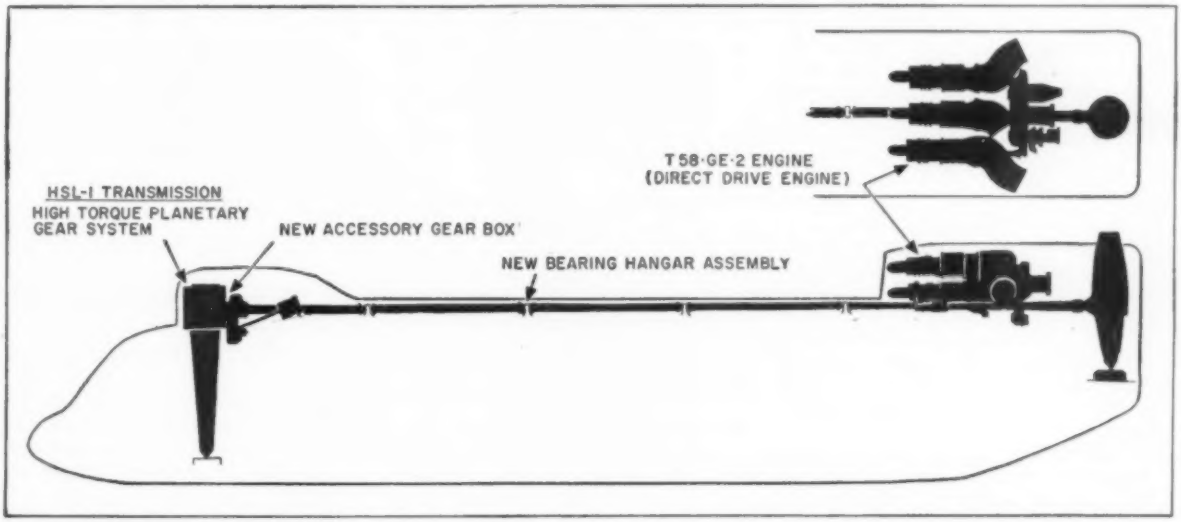


BELL AIRCRAFT'S design for D216A multi-purpose helicopter has **triple turbine** layout shown in drawing. Length is 41 ft.

Why Bell Favors Three Turbine Layout

New York—Bell Aircraft Corp., in proposing a triple-turbine helicopter, believes safety features of this installation far outweigh a small 1.5% payload to gross weight loss compared with a single turbine and offers either superior engine out performance or 15% more payload than a twin turbine.

Navy is showing interest in the Bell proposal, which calls for installation of three General Electric T58-GE-2 turbines—derated to 700 hp. each or total of 2,100 hp. at sea level—in a bailed HSL-1 helicopter. This test installation would duplicate that of the D216A multi-purpose tandem rotor helicopter which Bell proposes to develop.

Commercial Use

New York Airways began negotiations early this year with Bell for a 25-passenger triple-turbine (AW Mar. 19, p. 80).

At that time the design called for the Lycoming T53 engine, though the GE engine was to be usable. New York Airways and Sabena Belgian World Airways, another prospective commercial user, hope for military support for the development (AW Sept. 10, p. 23).

Bell compared single and triple turbine installations with each other and with single and triple piston engine layouts. It also compared twin with triple turbine installations. Bell's conclusions:

• **Single turbine** has a 10.5% payload to gross weight advantage over single piston at zero range which gradually narrows until 550 nautical mile range is reached. There the two become equal. Thereafter the single piston has the advantage. Using 200 nautical miles as an average operating range, the single turbine advantage is 6%.

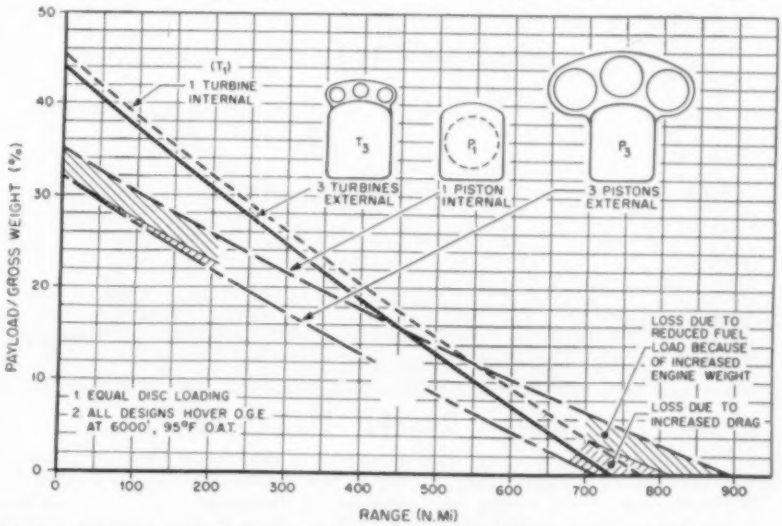
• **Triple turbine** offers 1.5% less payload to gross weight over the single turbine at zero range, a figure that widens only slightly as range increases.

• **Triple turbine,** at 200 nautical mile range, can carry 8.5% more of its gross weight as payload than a three piston engine installation. Since external mounting of triple engine layout is considered most likely, larger piston engines suffer drag penalties to a greater degree than the smaller turbine engines. (External mounting allows more cargo area, more flexible door and ramp design possibilities.)

• **Triple turbine** maintains payload advantages over either single piston layout up to about 450 mi. and over triple piston at all ranges up to 700 mi.

Bell concludes that the turbine engine has obvious advantages up to a range of 450 nautical miles.

These payload figures are all applica-



GRAPH compares payload to gross weight of single and triple turbines and pistons.

ble to rotor disk loadings under 5 lb. per sq. ft. As disk loadings increase, a progressive reduction in payload and increase in fuel consumption occurs. Installed power provides for out-of-ground effect hovering at 10,000 ft. pressure altitude at standard air temperature for the piston turbine comparisons, and also for the twin versus triple turbine comparisons which Bell turned to next.

Payload Advantage

Since the single turbine offers only a 1.5% payload advantage, Bell concluded the safety and reliability of a multi-engine installation far outweighed the cost.

Two major comparisons were made —installations with equal installed horsepower and installations of equal engine-out performance. Bell's conclusions:

- **Twin turbine,** in the case of equal installed horsepower, has only marginal single engine performance using takeoff power of the remaining engine. Triple turbine will hover outside of ground effect with one engine out, and has triple the rate of climb of twin turbine with one engine out.
- **Twin turbine** to have equal engine-out performance must have 133% the installed horsepower of triple turbine, resulting in one-third more installed powerplant weight and one-third more initial powerplant cost.

Other conclusions Bell derived in the equal engine-out performance study:

- **Triple turbine** would cruise at 67% normal rated power, twin turbine at 50% normal rated power. Since turbines operate more efficiently at higher settings, twin turbine would use 11% more fuel at 100 kt. cruising speed.
- **Powerplant weight** increase is equivalent to 10% loss in payload at 200 nautical mile range, and increased fuel requirement adds an additional 5% loss, for a total payload loss of 15%.

Adding a fourth turbine engine piles up cost and complexity for only a small gain in single-engine-out performance. Thus Bell settled for the triple turbine configuration.

In the test program Bell proposes for the HSL-1, problems of multi-turbine installation would be investigated, including the operational characteristics of best operating altitude, advantages of cruising with one engine shut down to increase range, best power settings, engine failure procedure, and starting techniques.

Best Configuration

Other phases of the test program:

- **Inlet losses.** Since any reduction in inlet losses means fuel saved, Bell would investigate the best configuration to utilize the ram effect of the rotor downwash and the relatively small ram available from forward flight.
- **Engine cycling.** Constant-speed governor maintains a selected rpm. in a turbine regardless of power requirements.

Rapid power changes may result in a lag or overspeed condition and cause cycling between engines in a multi-turbine installation. If transmitted to the drive shaft, this cycling may carry torsional oscillations to the structure.

Locating the rotor speed sensing unit as near the rotor head as possible has been described as a solution and

Dutch Ramjet Helicopter

Kolibrie H-3 helicopter which is being test flown by Nederlandse Helicopter Industrie, Rotterdam, has twin ramjet engines at rotor tip with separate fuel supply. Extreme high inertia rotor and low disk loading enable pilot to make fast jumps. H-3 recently was flown at overload conditions at all-up weight of 1,550 lb. Normal all-up weight is 1,325 lb. Empty weight is 450 lb. High payload compensates for high fuel consumption.

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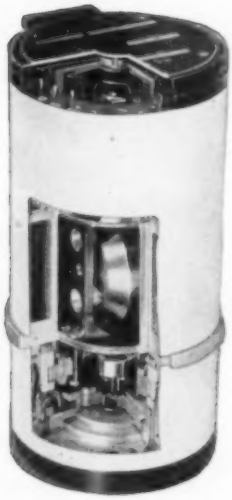

This is a cutaway view of Honeywell's HIG-5 hermetic integrating gyro. Compact: six inches high. Accurate: measures the thirteen-millionth part of a circle. Rugged: takes 50 g's and more of shock. The HIG detects and measures any attitude change of aircraft or missiles. Three models of the HIG (HIG-4, HIG-5, HIG-6) are in volume production. They are recommended for radar stabilization, flight control and inertial guidance.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL

The F-104A Starfighter is powered by the new J-79 turbo-jet engine with afterburner. At top speed, this engine develops half of its thrust as a ramjet. Operational altitude for the speedy fighter is the upper stratosphere.

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Bell would study governor arrangement.

• **Power measuring.** Turbine power output varies for various compressor inlet temperatures at constant tail pipe temperature. A torquemeter to measure increases in power to the rotor system when operating below standard day temperatures as an adjunct to tail pipe temperature measurement is desirable. Bell proposes to develop, with GE, an electronic phase detection torquemeter and power turbine overspeed governor.

Liquefied Hydrogen Keeps Balloons Aloft

Liquefied hydrogen at −423F is being used to keep weather balloons aloft many hours longer than usual.

Method of replenishing a high-altitude weather balloon's lost gas while it is still in flight was discussed at the 1956 Cryogenic Engineering Conference at the Boulder, Colo., laboratories of the National Bureau of Standards.

A specialized container that holds nearly 120 gal. of the liquefied hydrogen is attached to the balloon for refueling purposes. When the balloon sinks below a specific altitude, due to loss of gas, a valve on the container automatically opens. Valve releases cold liquid which, as it passes through valve and over warm-up coil, reverts to gas.

Engineers for Cambridge Corp. developed the device at the Air Force Cambridge Research Center.

Air Force Awards Contracts for T53

Lycoming Division of the Avco Corp. has received a $2,900,000 preproduction tooling contract for the T53 gas turbine from USAF Air Material Command which is monitoring the engine project for the Army.

This follows the $1,140,000 from AMC for T53 product improvement to gain higher power with less weight (AW Aug. 27, p. 62) which was received about a week earlier. However, the turbine contracts are smaller than the $14,069,950 contract which Lycoming received from the Air Force for the reciprocating engines which they are building under a Curtiss-Wright license.

Army has been backing the T53 for the Bell XH-40 utility helicopter. According to present schedules, the XH-40 will be the first gas turbine powered helicopter to be produced in quantity for the armed services.

In addition, Lycoming is developing an engine similar to the T53, but with considerably higher horsepower ratings. Lycoming also is adapting the T53 for Navy use.

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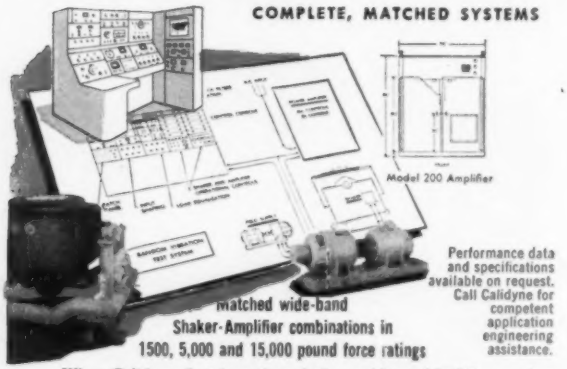

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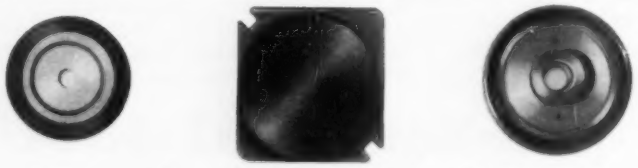

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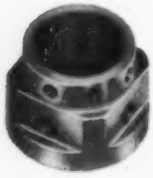

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Russian Theory

Split-compressor theory is outlined in these pages from a Russian textbook on general design features and characteristics of turbojet engines. The text says in part: "In order to get longer blades in the last stages and also higher values for efficiency, a dual-rotor or dual-cascade compressor arrangement is used with high-pressure axial compressors. At the same time, the compressor stages are divided into two sets, forming two rotors with approximately the same circumferential blade speeds, but with different average diameters—greater on the first rotor and smaller on the second rotor.

The first rotor turns at a lower rpm. than the second. Rotors are driven either by two turbines which have different rpm. (Fig. 58), or by one turbine, using a reduction gear between the compressors (Fig. 59).

Because of the decrease in average diameter of the stages of the second rotor, the blade length of the final stages increases, leading to an overall increase in the efficiency of the compressor. The two-rotor compressor arrangement also has other advantages. The operational qualities of the engine are improved. You are able to get a steady operating regime without the need for variable stators and without bleeding the air from certain stages."

USSR's Vladimir Matvejev starts his model in the recent world championship Wakefield (rubber powered) contest held in Sweden. Though this was the first time the Soviet Union had ever competed in a world championship, the Russian team averaged out second place in a field of 19 nations. Note criss-cross wing structure.

Russians Bring Unusual Designs to Wakefield Model Competition

Stockholm—Russian model airplane builders brought some unusual designs with them for the 1956 Wakefield competitions at Höganäs, Sweden. The 4-man Russian team, with only one model of conventional design and material of five that were brought, placed second to Sweden in the team competitions.

Britain was third and U. S. fourth.

Distinctive about the Russian models was the use of a strong, thin grass from the Steppes for ribs.

Wing surfaces were highly cambered and instead of balsa ribs the Russians used diagonally sprung reeds to form a geodetic structure. Tail surfaces had the same construction.

Russians said the grass was much stronger and lighter than balsa, and, used in the wings, produced a very thin section. However, a Swedish expert who lifted one of the Russian models doubted if there was much weight saving, if at all. In any case, the grass is much harder to work with than balsa.

Some Balsa

The Swedish observer assumed the wing edges and all spars in the airframe were made of balsa. Frame was covered with ordinary Japan paper. (However, another observer reported that the covering was condenser paper.) He summed up the design he examined as well-calculated and well-built but not right for the bad weather that prevailed at Höganäs.

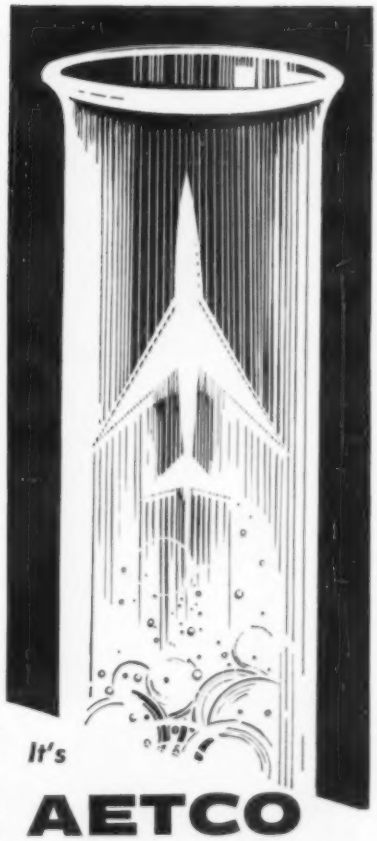
Another feature of the Russian models was that the propellers had adjustable pitch. (They were all of the fold-back type.) The round root of each blade fit into a cylindrical socket perpendicular to the spinner axis. The blade was held in place by a spring clamp, and when the clamp is opened the blade is loose in the socket.

Several facts indicate the Russians were getting more than token support from the Soviet government. They flew to Stockholm, though their rather shabby clothes did not mark them as members of the airline riding income group. They had two attachés on hand from their embassy at Stockholm. They had along a team-leader as extra baggage.

Seedy Trophy

A sidelight to this year's Wakefield: the Russian team leader presented the host, Royal Swedish Aero Club, with a trophy as a token of appreciation. This act of thoughtfulness drew great applause from the audience, which viewed from a distance cut-glass crystal with etched scenes of Moscow. The recipients were in closer touch with reality. The trophy was of poorly fabricated plastic, the scenes ordinary presswork.

Of the four U. S. competitors in the event, two were unable to obtain travel funds to accompany their models and the other two paid their own way. One of the absent owner's craft, which was flown by a Swedish proxy, placed ahead of both the U. S. models flown by their owners.



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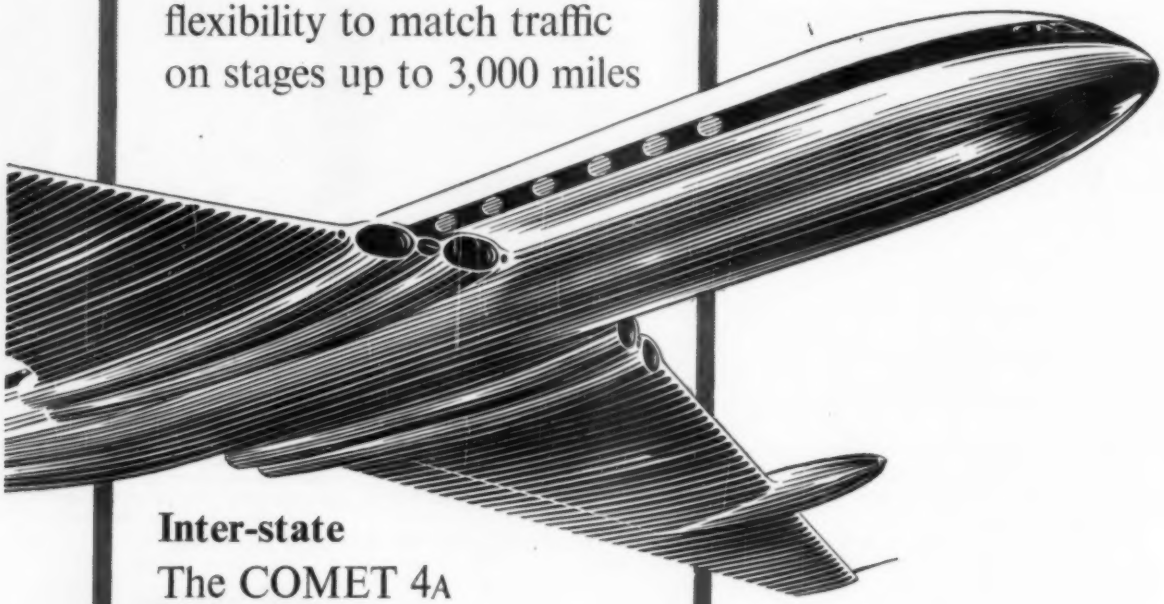

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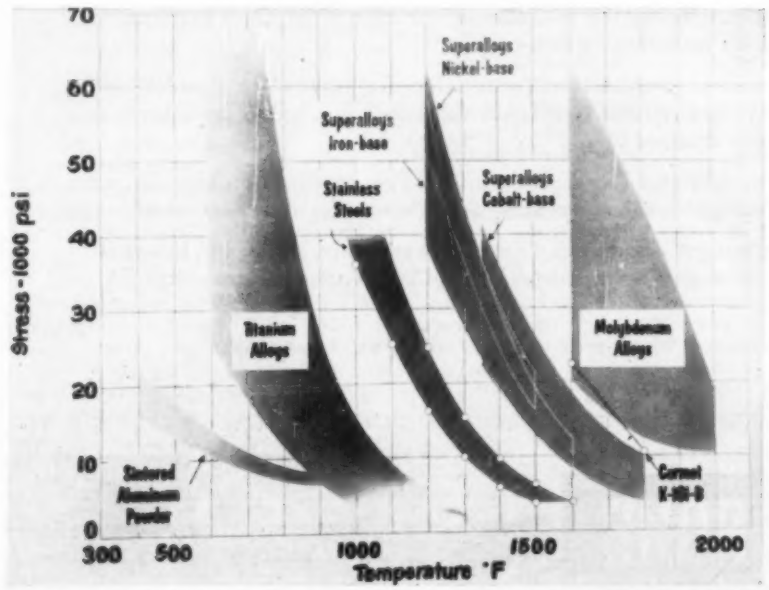
METALLURGICAL INVESTIGATIONS form a definite part of the efforts at Westinghouse's Research Laboratories, many of them directed toward greater strengths at high temperatures of concern in aircraft propulsion. Laboratory vacuum furnace (right) has been used by Westinghouse metallurgists to produce 1800F inconel clad molybdenum turbine blade material. Technique to visualize the internal structure of metals (left) makes use of soap bubbles which have a tendency to join and balance in much the same way as metal atoms do. Soap bubbles blown out upon glass duplicate the crystal structures of metals.

Westinghouse Designs Laboratory As Source for Basic Knowledge



INCREASINGLY higher temperatures met in turbojet engine operations and high speed flight have spurred studies of metal. This Westinghouse graph shows alloy temperature-strengths.

By Robert Cushman

Pittsburgh, Pa.—Westinghouse's Research Laboratories are meant to be a company-wide source of new basic scientific knowledge. Recently rehoused in Pittsburgh's Churchill Borough, the facility is comparable to Bell Laboratories' Murray Hill, N. J., laboratory (after which the building was patterned) and quite similar to General Electric's General Laboratory in Schenectady, N. Y.

Seven acres of floor space houses 450 scientists, laboratory technicians and assistants, and $1 million worth of equipment.

In Westinghouse's public display of the laboratories, the following appeared to have special implications for the company's future aviation interests:

• **Metallurgy.**

Westinghouse has developed a method of cladding molybdenum with Inconal by interjecting a thin sandwich of palladium. Westinghouse feels that this will permit turbine inlet temperatures of 1800-1900 F.

Generally Westinghouse feels that metallurgy must become more of a conscious design process than the present guess-and-try. It points in this respect to their Nivco alloy which was designed to have built-in magnetic

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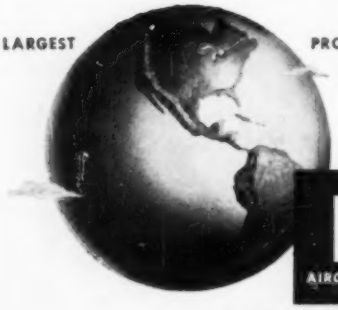

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AIRCRAFT CORPORATION

CHULA VISTA AND RIVERSIDE, CALIFORNIA

damping at 1,200F temperatures.

• **Light Amplification.**

Two methods were displayed. One was through a television system which used the Westinghouse Ebicon (electron bombardment induced conductivity) television camera pick-up tube. When light photons struck the outer face of the tube, electrons were emitted from the other side. These electrons are shot through a storage target consisting of an aluminum-coated metal screen and a selenium semiconductor which both multiplies and stores the electrons. Potentially Westinghouse feels that this system has limitless amplification possibilities.

The other method of light amplification made use of a series of diaphragms under the influence of electromagnetic fields. For every electron which strikes one side, four are emitted on the other. A four-disk model (a few inches in diameter) was on display. The scientists said it was scheduled to increase the Mount Palomar telescope's photographic range three-fold.

• **Automation.**

Mathematics Department (first to be officially recognized as such by industry) has a computer with "curiosity." Theories of the statistical design of experiments were utilized to program a computer so that it would search for an optimization of any function given to it. Although the Automax does use some servomechanism principles, it goes beyond servos, which only act when they receive an error signal through their pre-arranged feed-back circuit. Automax stimulates itself into action even when no error signal is being fed back.

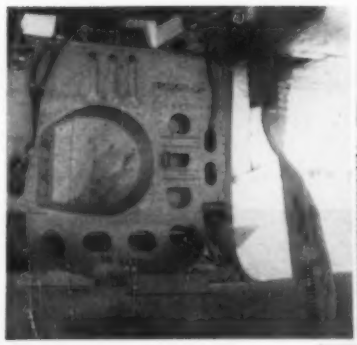
For example, after it had found the one high point on a simple contour map mountain climbing problem, it searched to check that it really was on the highest point. Westinghouse feels that this device will have important contributions to make for random process controls such as air traffic.

• **Low Temperature Research.**

Cryogenics, as this relatively new art is called, is one of the major pursuits of the laboratories. Westinghouse is using ultra-high-frequency microwaves to study the structure and effects of superconductivity of metals when their temperatures are lowered to within a few degrees of absolute zero.

One of the most promising uses for this phenomena is in miniaturizing the memory circuits of computers to the point where what is now a roomful of magnetic tapes, drums and tubes can be packaged in an aircraft.

In philosophy of operation the laboratory endeavors to attract top creative research scientists by promising an interest in their personal research interests and de-emphasizing requirements for immediate profit to Westinghouse.



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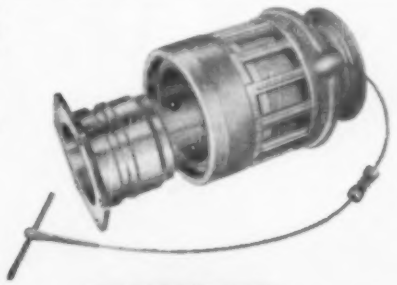
Completing the hose-coupling assembly is the Roylyn 7643-48 Air-Start Coupling. This popular "Quick" coupling meets all Air Force requirements and also has an exclusive butterfly valve for prevention of hose-whipping. Provides two methods of disconnect—lanyard and manual. Tested for pressure, temperature and endurance in accordance with Air Force procedure.

A PERFECT COMBINATION!



Roylyn

INCORPORATED
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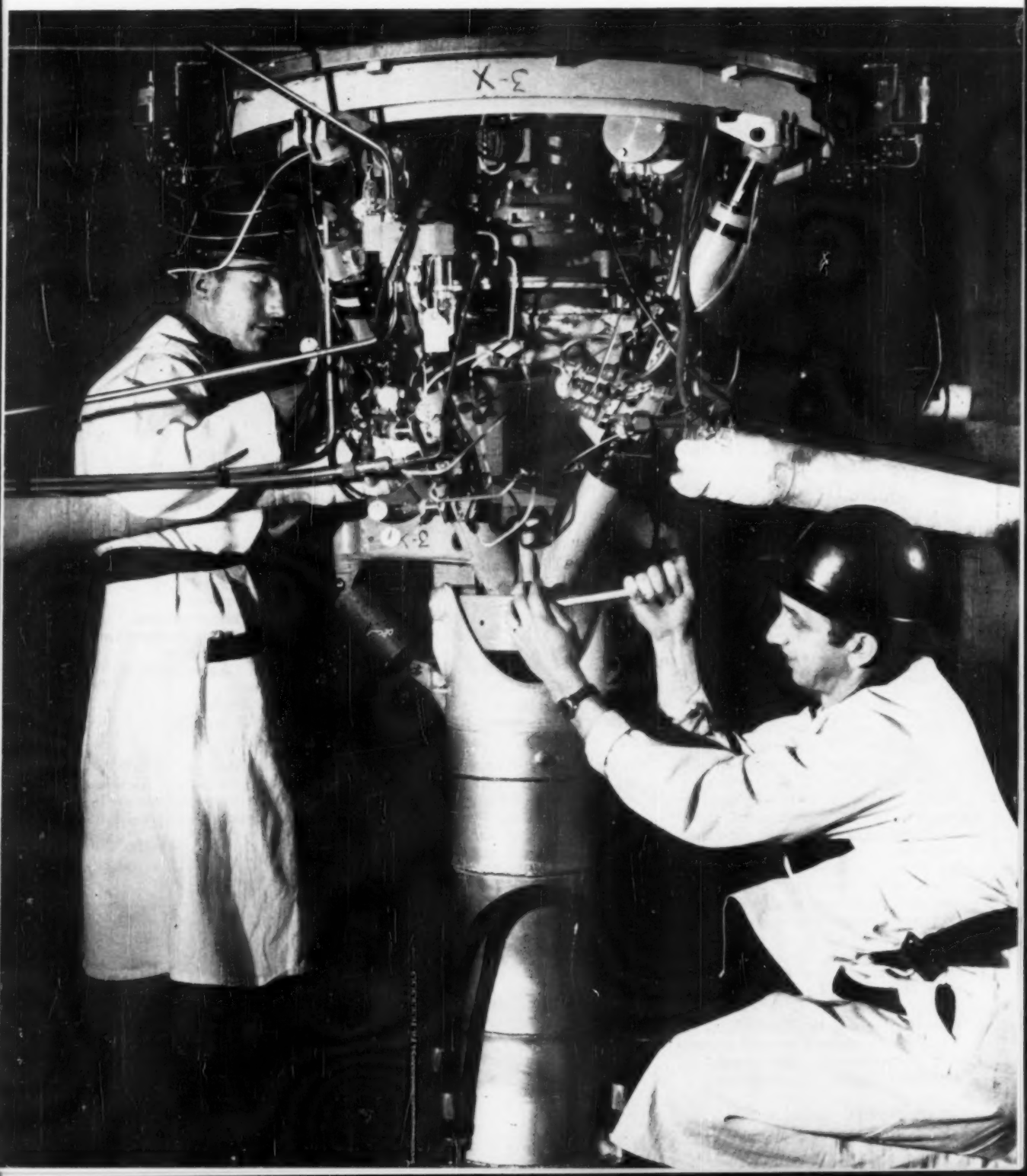
PROGRESS REPORT ON PROJECT VANGUARD

General Electric X405 to



Propel 11-Ton Rocket 4000 mph

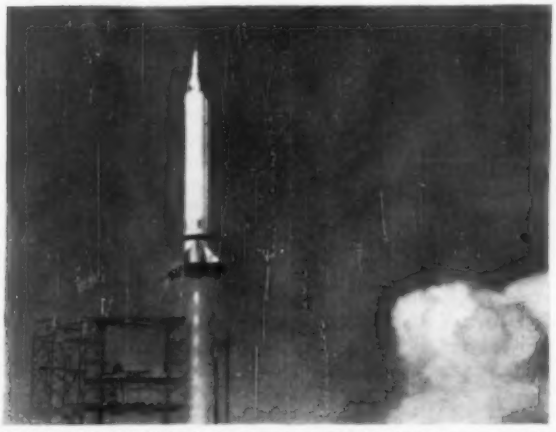
New G-E rocket engine delivers more than 27,000 lbs thrust for about 150 seconds to accelerate earth satellite vehicle.

A powerful new General Electric rocket engine—the X405—will deliver a thrust of more than 27,000 pounds when it launches the 11-ton, three-stage VANGUARD rocket during the International Geophysical year. Main power boost for VANGUARD, G.E.'s powerplant will propel the multi-stage finless rocket through its initial 36 miles of flight toward outer space.

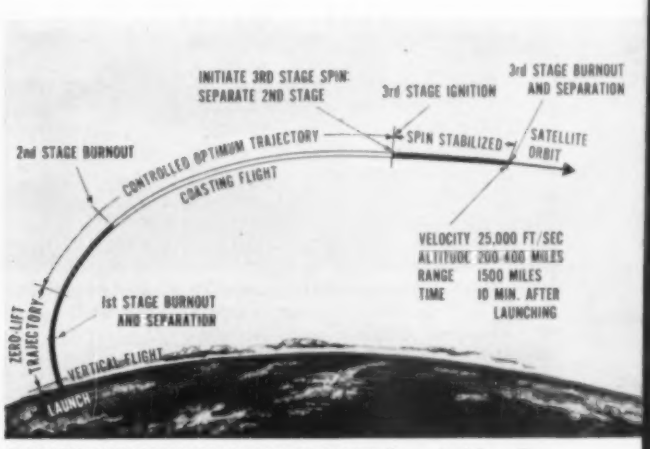
Burning a hydrocarbon fuel and liquid oxygen, G.E.'s highly efficient X405 will run for about 150 seconds. At burnout, the X405 will have accelerated the VANGUARD rocket to a speed of 4000 mph—more than a mile a second!

Advanced components, including a turbopump and thrust chamber, characterize the X405. The turbopump makes possible a high chamber pressure and delivers the superior performance required for VANGUARD'S very long-duration, high-altitude flight. It will also be gimbal-mounted to permit changing thrust direction as much as 5° for accurate flight path control.

The superior performance of G.E.'s X405 results from data obtained from past flight-proven G-E liquid propellant systems. More than a decade of rocket engine experience has enabled the G-E rocket team to answer quickly, and successfully, the challenge of VANGUARD. The X405 is still another reason why General Electric today is able to offer the U.S. rocket industry highly reliable, high-performance rocket powerplants . . . of unmatched quality. 234-8



MARTIN BALTIMORE'S ROCKET EXPERIENCE, illustrated by the Viking above, led the Navy to select the company as prime contractor for PROJECT VANGUARD.



FLIGHT PLAN OF FIRST EARTH SATELLITE. Launched from Patrick AFB, Florida, the satellite will establish an orbit that will permit scientists of many nations to observe its flight path.

ENGINEERS AND SCIENTISTS—*Expansion is creating vast opportunities at General Electric in rocket propulsion.*
For illustrated brochures, write Technical Recruiting, Bldg. 100, AGT, General Electric Company, Cincinnati 15, O.

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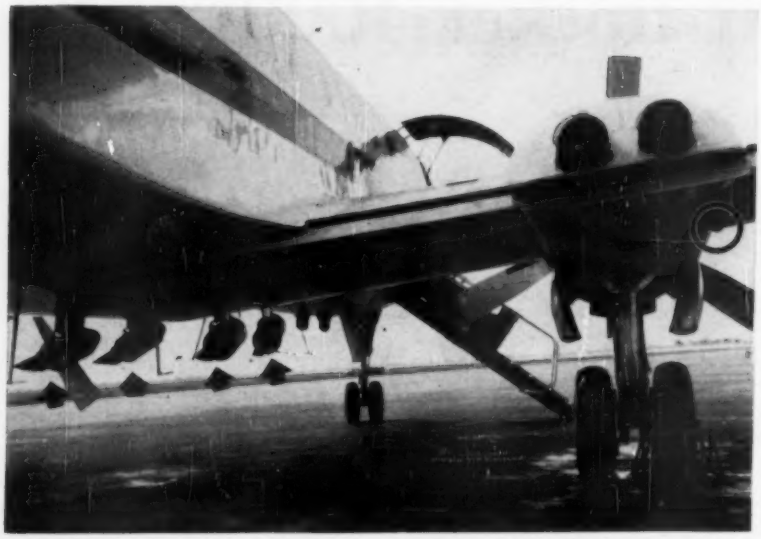
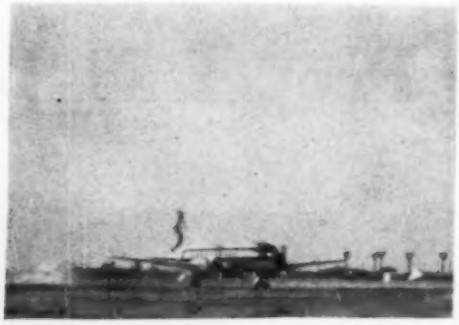


ARROWS point to four 1,000 lb. thrust Aerojet-made Jato bottles mounted externally under the fuselage of an Esso-owned Convair 240. The rocket engines are located two forward and two aft. Two additional Jato units are flush-mounted outboard in engine nacelles. One is shown in the circle at right.



NACELLE Jato-assist-takeoff.

FUSELAGE Jato-assist-takeoff.

Jato Shortens Business Plane Takeoff

By George L. Christian

Millville, N. J.—Performance credit—in the form of shortened runway takeoff length requirements—has been granted to Jato-equipped executive aircraft by the Civil Aeronautics Administration.

In an interim ruling, the CAA has granted runway length reductions to Jato-equipped planes equal to approximately 25% of the difference between the all-engine distance and the one-engine-out takeoff distance. Thus, if a plane requires 3,000 ft. to clear a 50 ft. obstacle with all engines operating and 4,000 ft. with an engine out, runway credit earned by Jato would be 25% of the 1,000 ft. difference, or 250 ft.

Transport Use

Permitting use of Jato as rocket assist for gas turbine powered transport aircraft is now under consideration by the Civil Aeronautics Board. Currently the Board is considering reduction in runway length for such aircraft, if Jato equipped, equal to 50% of the distance between all-engine and one-engine-out takeoff distances. The philosophy expressed in this regulation would be extended to cover current, piston-powered aircraft.

No formula was used to arrive at the 25% business plane figure. Theoretically one engine out would be entirely replaced by Jato, but the CAA did not want to remove all safety margin. Thus the choice of 25%, not 50%.

Moreover, the CAA allows takeoff weights of Jato-equipped planes to be increased enough to compensate for the installed weight of the rockets provided this weight increase does not exceed the maximum structural limitations of the aircraft. Maximum of 200 lb. per bottle is allowed.

New orders for rocket-assist for executive aircraft are being received by Aerojet-General, originators of Jato and makers of the rocket engines (AW Nov. 28, 1955, p. 60). Example is a major oil company which operates 22 multi-engine aircraft and which is having its entire fleet Jato-equipped, according to Aerojet. The company states that, "The oil company's reasoning is that each airplane represents an investment up to $1 million and usually carries the firm's top executives. Therefore, the company could not afford to disregard a safety device which makes 1,000 lb. of thrust per unit (approximately equivalent to 450 hp.) instantly available at the flick of a switch.

The rocket engines are labelled 15K-S100-A1 Jato and are the only such rockets to be certificated for use on commercial aircraft by the CAA. Each bottle weighs 144 lb. installed, of which 72 lb. is burned off in firing. New virtually smokeless rockets are replacing the old, smoke emitting units which saw wide service on military aircraft.

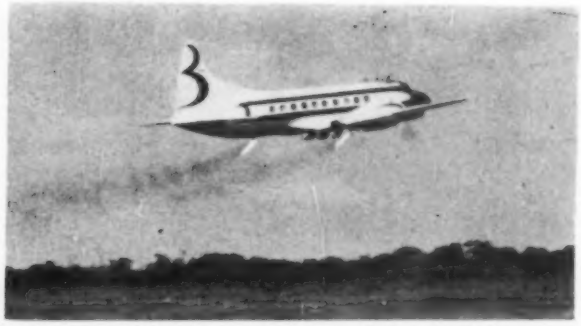
Aerojet is establishing a nationwide distributorship for commercial Jato, and also is expanding into the Canadian market.

Currently the company lists nine distributors with eleven outlets in the U. S., plus a twelfth at Montreal Airport in Canada.

In addition, Aerojet lists 16 fixed base operators (including two airlines) as qualified modification centers. Among them are: Lockheed Aircraft Service, Ontario, Calif., and Jamaica, N. Y.; Pacific Airmotive, Burbank, Calif.; Southwest Airmotive, Dallas, Tex.; L. B. Smith, Miami, Fla., and Butler Aviation, Washington, New York and Chicago.

Rocket Ride

A ride in Rockwell Manufacturing's Lockheed PV-1, equipped with three, standard 1,000 lb. thrust Jato units, gave convincing proof how a marginal single-engine takeoff could be immediately transformed into a safe single-



MAIN gear starts to retract as two Jatos boost plane into the air. Nacelle Jato still firing after gear retracts and Convair climbs.

FOUR under-fuselage Jato units, two forward, two aft, firing. Convair tucks away landing gear as Jato assists its climb-out.

Requirements

engine takeoff with the benefit of rocket assist.

The PV-1 flight demonstration was made before a group of executive plane pilots, aircraft parts distributors, and airline technicians attending the seventh annual Pratt & Whitney Aircraft-Airwork Corp. Engine Operation & Maintenance Forum at Airwork's Millville headquarters.

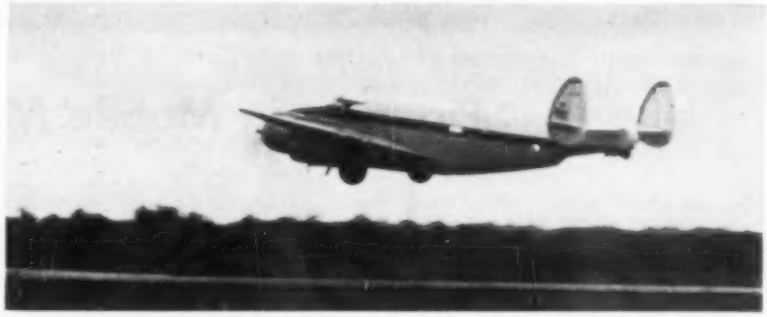
Pilot J. L. McClure made two single-engine takeoffs—the first without Jato, the second with it. On both runs he pulled the right throttle full back to the stop as he lifted the plane at V_1V_s (both values were the same for the PV-1 considering takeoff conditions and runway length at Millville Airport).

The right propeller was allowed to windmill during both flights.

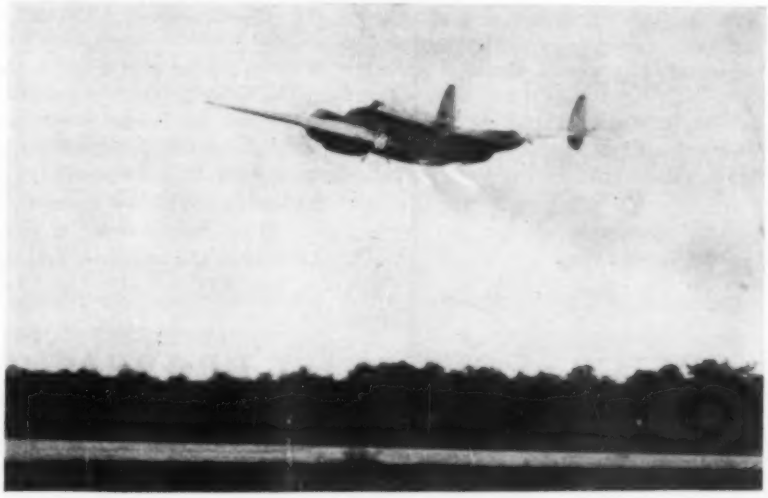
On the first takeoff, the aircraft yawed severely. A painfully slow rate of climb brought the plane to the maximum altitude it could attain for a circuit of the field—75 ft.

Indicated air speed ranged from 132 to 136 mph. From the cabin, it appeared that the right engine had to be brought in momentarily during the turn into final (the turn was into the good engine, or to the left) to align the plane with the runway.

On the second takeoff, two of the



ROCKWELL MANUFACTURING'S Lockheed PV-1 takes off on single engine without Jato (above) and with Jato (below). Right engine is windmilling.



Notable Achievements at JPL

***THE CORPORAL, A MOBILE SURFACE-TO-SURFACE MISSILE SYSTEM** was developed by JPL. In addition to the Corporal missile itself, JPL was responsible for the creation of the guidance, launching, handling and servicing equipment needed for a truly complete mobile guided missile system.*

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During the development of the Corporal system, JPL gained a deep appreciation for some of the problems associated with the creation of a completely mobile tactical system. The experience obtained is now being applied in the design of new surface-to-surface weapon systems.

In its missile system and jet propulsion undertakings, the Laboratory maintains a broad technical responsibility, from basic research to prototype engineering. By virtue of the Laboratory's broad area of responsibility and the integrated nature of the JPL technical staff, an individual scientist or engineer is brought into satisfyingly close contact with the general field to which his technical specialty contributes.

The Laboratory occupies an 80-acre plot in an otherwise residential area in the San Gabriel mountain foothills North of Pasadena. Its staff of approximately 1,250 persons are all employed by the California Institute of Technology, and it conducts its several projects under continuing contracts with the U.S. Government.

If you are interested in knowing more about the Jet Propulsion Laboratory and its specific employment offerings, please write.

CALTECH jpl **JET PROPULSION LABORATORY**

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA

three Jato bottles were fired immediately after the right engine was cut, again at V_1V_2. McClure attempted to fire the third bottle seven seconds after the first two (total burning time is 15 sec.), but it failed to ignite.

The two bottles that did ignite fired off almost simultaneously with rifle-like reports.

The ensuing sound produced by the rocket charge was a high hiss.

Lurid purple-red reflections on the PV-1's wings were visible evidence that the Jato's bottles were firing. The only smoke visible was a slight streamer as the bottles burned themselves out.

With Jato-assist, McClure was able to reach 570 ft. and indicate 150 mph.—obviously a much safer altitude and speed for single engine operation. (Millville Airport has an elevation of 87 ft., the temperature at the time of the flight was about 80F.)

Although the Jato units produce full thrust within ⅛ - ¼ of a second after firing, there is no sudden sensation of being thrust forward. Actually, there is very little feeling of surging ahead.

Cockpit Circuitry Checker

After landing the second time, Aerojet representatives investigated the reason for the third Jato unit's failure to fire.

Most probable cause, they said, was dirty contacts on the firing switch, which had not been used for several hundred hours. The firing circuits, from switch to Jato igniter, were rung out and found to be in working order.

Aerojet has come up with a cockpit circuitry checker which will be standard

Commercial Jato Distributors

Aero Corp., Atlanta Airport, Atlanta, Ga.

AiResearch Aviation Service Co., Los Angeles International Airport, Los Angeles, Calif.

Dallas Aero Service, Love Field, Dallas, Tex.

General Aircraft Supply Corp., Detroit City Airport, Detroit, Mich.

Howard Aero, Inc., Manufacturing Division, International Airport, San Antonio, Tex.

Lund Aviation, Inc., 230 Park Ave., New York, New York.

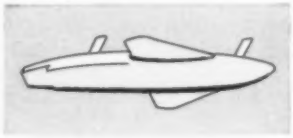
Lund Aviation (Canada), Ltd., Montreal Airport, Dorval, Quebec, Canada.

Northwestern Aeronautical Co., Holman Field, St. Paul, Minn.

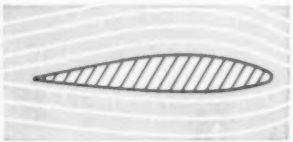
Remmert-Werner, Inc., Lambert Field, St. Louis, Mo., Toledo, Ohio, and Pompano Beach, Fla.

Spartan Aircraft Co., Aviation Service Division, Municipal Airport, Tulsa, Okla.

Now even the ice- and snow-covered Arctic regions present no landing problems to aircraft whose design includes the Pantobase landing system. A product of Stroukoff research and development, Pantobase will permit landings and take-offs from snow, ice, sand, water and unimproved terrain, thereby extending the operational capabilities of the aircraft and reducing the need for conventional airports in many remote and previously inaccessible parts of the earth's surface.



Pantobase—When designed into an aircraft the Pantobase system enables the plane to land and take off from many types of surface without changes or additional landing equipment.



BLC-Boundary layer control as developed by Stroukoff increases the effective lift and delays stalling of the wing, thereby reducing required speeds and distances for take-offs and landings.

Achievement is a tradition at Stroukoff. A leader in the development and design of cargo and transport aircraft, Stroukoff offers challenging opportunities to creative engineers.

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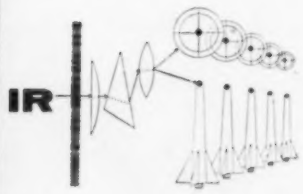
INFRA-RED IS ULTRA-MODERN



In the post-war years, the development of infra-red devices has attained the dimensions of a technological breakthrough. In this period, the Electronics and Guidance Division of Aerojet-General Corp. has become the national leader in the development and manufacture of infra-red equipment.

Aerojet offers qualified engineers and scientists unparalleled opportunities in every area of the guidance and propulsion field.

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equipment on all future Jato installations, and which will be CAA-mandatory equipment if the Jato-equipped aircraft is to be eligible for any bonuses—such as higher permissible takeoff weights or shorter takeoff runway lengths—resulting from the Jato. A retrofit circuitry checker kit is available for $135. Weight is negligible, according to Aerojet.

The checker allows a very small amount of current—milliamps coming from a 1½ v. battery—to flow through the actual firing circuit of the Jato bottle. The amperage is well below the 4-25 amp. required to ignite the rocket. Sensitive ohmmeter tells the pilot instantaneously whether the Jato firing circuit is operative. This check may be made at any time on the ground or in flight and becomes part of the pre-flight check list.

Had such a checker been installed on the Rockwell PV-1, McClure would have been able to detect the inoperative third rocket before he attempted to use it.

In the existing firing circuitry there is a safety switch tied in with the landing gear shock strut which prevents inadvertent firing of the rockets while the aircraft is on the ground to protect plane and personnel. An override switch is provided to permit intentional ground firing in case it becomes necessary.

Flick a Switch = 450 HP.

Aerojet technicians say that, at approach or V_2 speed, each Jato develops about 450 hp. (equivalent to the takeoff power of a P&WA R-985).

The three-bottle installation in the Rockwell PV-1 weighs less than 500 lb.

Aerojet cites these acceleration figures: "With an engine out, or 50% power, plus the thrust of two 1,000 lb. thrust rocket engines, a 30,000 lb. gross weight PV-1 accelerates from 110 to 150 mph. in 6 sec.; a 27,000 lb. gross weight B-25 from 120 to 155 kt. in 5 sec. and a 26,900 lb. gross weight DC-3 accelerates from 97 to 115 mph, in 2-3 sec."

Aerojet engineers feel that this reserve source of power gives sufficient acceleration to permit emergency action to be initiated. Possibly it could have averted many accidents of both executive and commercial aircraft.

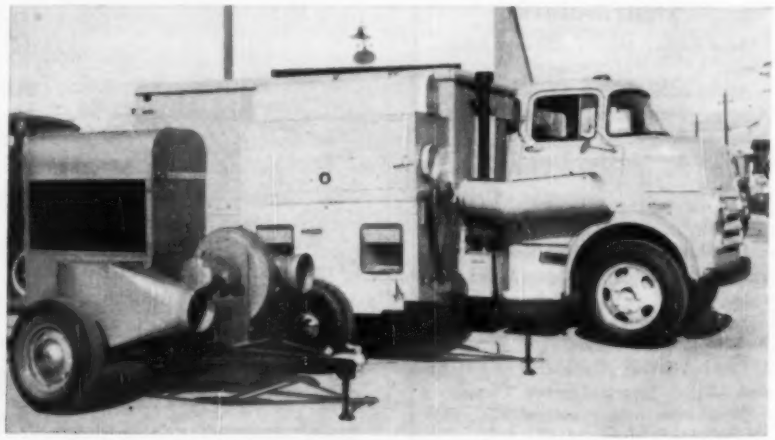
To bolster this premise, company spokesmen cite these statistics, based on CAA Air Carrier Accident Reports for 1954 and 1955, and for 1949 through 1955:

"These studies show that, of the fatal air carrier accidents in 1954 and 1955, 15% occurred at takeoff, 60% happened en route, and 25% occurred on landing. In executive flying in the period from 1949 through 1955, fatalities were divided as follows: 22% on takeoff, 52% en route, 26% on landing.

"Additional thrust for a few seconds during the critical period might have prevented or reduced the seriousness of 45% of the fatal air carrier accidents and 48% of the fatal executive flying accidents—resulting in the saving of as many as 191 lives.

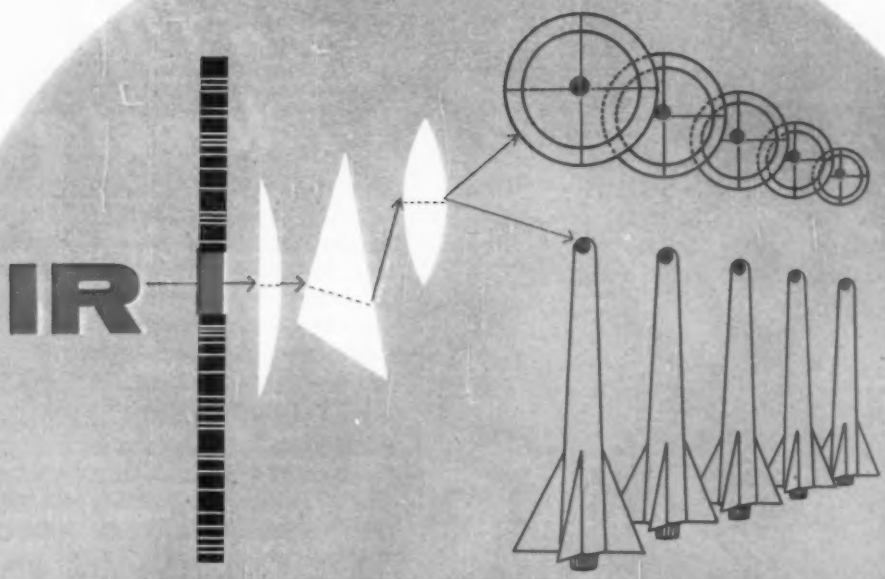
"Standby thrust might have prevented 100% of the takeoff, 25% of the en route and 60% of the fatal air carrier landing accidents. It might also have prevented 83% of the takeoff, 29% of the en route and 57% of the fatal landing accidents of executive aircraft . . ."

Aerojet says that, considering domestic and overseas scheduled and non-



Air Conditioning Trio

This portable air conditioning trio was recently completed by Airtemp division, Chrysler Corp., for three separate divisions of Lockheed Aircraft. Small unit at left is a 3-hp., waterless machine designed for guided missile use. Center unit is a 5-hp., air-cooled air conditioner. Rear, truck-mounted machine is a 20-ton unit designed to cool aircraft cabins.



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Write or call for information on TDI's comprehensive coverage of the remote instrumentation field. Technical literature sent on request.

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Executive Jato Orders

Executive aircraft which have Jato installations:

Convair 240—Esso Shipping Company, which engineered its own set-up.

Lockheed PV-1—Rockwell Manufacturing Company.

North American B-25 — Lawrence Warehouse Company, Northern Ordnance, Timken Roller Bearing Company.

Douglas DC-3—Esso Shipping Company, Holley Carburetor Company, Kearney & Trecker, Line Material Company, M & G Corporation, Aerojet-General.

Executive aircraft with Jato installations in progress or soon scheduled to start:

Convair RBY-5A—Field Aviation.

Lockheed Lodestar—Service Pipeline Company (2), Timmins Aviation of Montreal.

Howard Super PV-1—Fruehauf Trailers, Gamble-Skogmo, Gulf Oil Company, Kudner Agency, National Distillers Products, Socony-Mobil Oil.

Douglas DC-3—Olin-Mathieson, Zollner Corporation, Esso, Aerojet-General.

scheduled passenger and freight operations for 1953, the numbers and categories of accidents which might have been precluded or reduced in seriousness are as follows:

- **Power loss** on takeoff—4.
- **Undershooting** landings—5.
- **Undershooting** landing after enroute or approach power loss—3.
- **Gusty crosswinds** or gusty windshifts—2.
- **Couldn't stop**—ice or water on runway—2.
- **Ice on aircraft**—3.
- **Turbulence and downdraft**—1.
- **Fuel shortage** near airport—1.
- **Bounced take-off** and porpoising at high elevation—1.
- **Bounced landing** and attempted go-around at high elevation—1.
- **Collision** with truck driven onto runway—1.

The total is 24.

Airline Use

Airlines use Jato to help planes take off from high altitude runways.

Among commercial users are Panagra, American, Braniff, Ethiopian and TACA.

Recorded instances of Jato helping commercial pilots out of tight situations where engines were producing full power include an aircraft whose acceleration was slower than anticipated because of slush and snow on the runway. Another occurred when a sudden wind shift took place with the plane too far down the runway to stop. (Both incidents happened at La Paz, whose air-

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Turcoat 4178 works on the surface conversion principle... that is, the coating is partially derived from the metal itself. Thus, coating and metal are *firmly interlocked*... even in tiniest crevices. The coating is a light golden color that imparts a special beauty when used for decorative purposes.

One user reports that square footage processed has *doubled* since the installation of Turcoat 4178. Key to this speed is the manner in which the coating "sets" and becomes non-smearing immediately. Drying is unnecessary. Parts can be further processed *without any delay in production!* Moreover, the coating is *uniform*. There are no light, tell-tale untreated sections around welds, corners or holes.

The Turcoat 4178 Coating becomes non-smearing immediately upon withdrawal from processing. Drying is unnecessary. Parts can be handled freely **while still wet** without danger of smearing or streaking coating.

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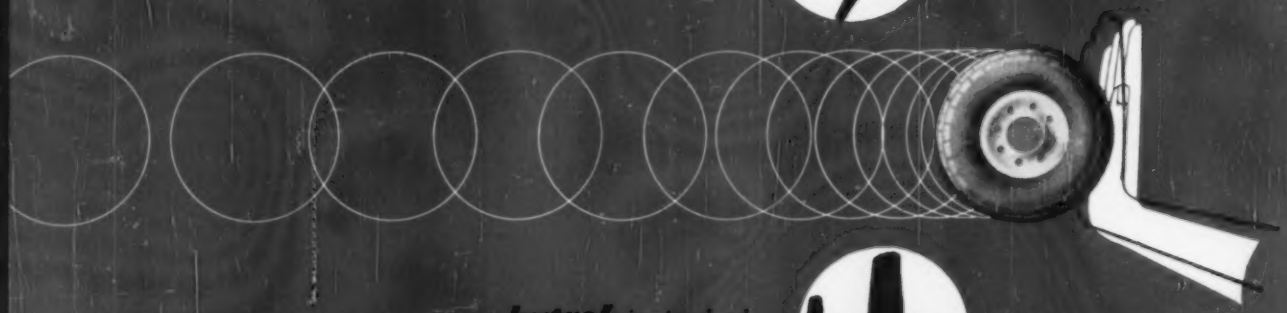
hytrol *is standard equipment on the B-52*

hytrol *is standard equipment on the B-66*

hytrol *is standard equipment on the ASD*



hytrol *is standard equipment on the RF-81F*

hytrol *is standard equipment on the F-100C&D*

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Aerojet-General, a subsidiary of General Tire & Rubber Co., has developed a junior Jato which is in the process of being certificated by the CAA. Approval is expected before the end of the year.

The small-size bottle will deliver 250 lb. of thrust for 15 sec.—equivalent to about 100 hp.—will weigh 40-43 lb. or about 50 lb. installed. It is designed for planes ranging in size from Piper Cubs to Beech Model 18s.

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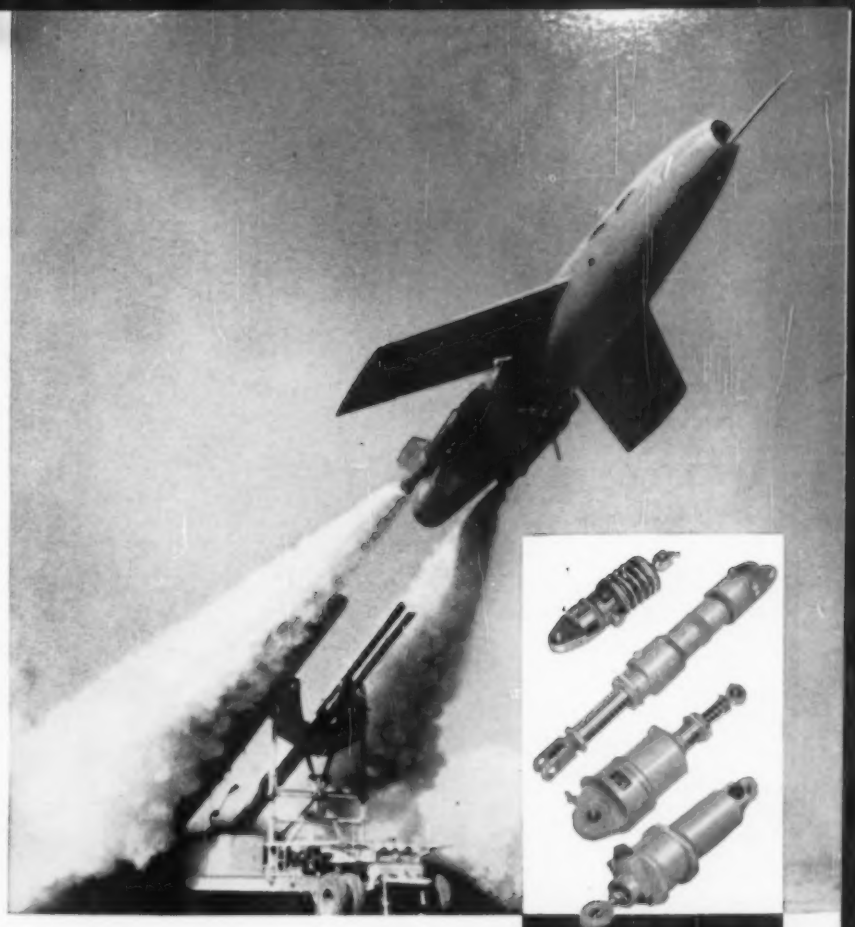
Coast-to-coast network of aviation fire extinguishing system recharge and service stations has been established in the U. S. and Canada by Walter Kidde & Company, Inc.'s Aviation Division. Twenty-four hour service is available at many cities which are also maintenance or production centers for major airlines or airframe manufacturers. Kidde maintains similar stations overseas and will add facilities as they are needed.

Sales agreement has been reached between Consolidated Electric Corporation, Stamford, Conn., and Daiichi Bussan Kaisha, Ltd., Tokyo, for the latter company to sell in Japan the multi-purpose ground support equipment for jet aircraft that Consolidated Diesel is supplying to the U. S. Navy and Air Force.

Price reduction of 3-7% for "Scotch" brand PTF electrical insulation films and tapes was announced by Minnesota Mining and Manufacturing Co. All PTF tapes are made from high temperature resistant Teflon resin.

New, 10,000 lb. capacity electric, stand-up, center control fork truck has been put on the market by Elwell-Parker Electric Co. The new model, labeled R10T, features front wheel drive and rear wheel steering and has a speed of 4 mph. fully loaded. The truck has four speeds forward and reverse, and combines direction and acceleration in a single hand control lever. Address: 4205 St. Clair Ave., Cleveland 3, Ohio.

Pratt & Whitney Aircraft R-2800 engines powering the DC-6As operated by The Flying Tiger Line and Slick Airways will be overhauled by Pacific Airmotive under long term contracts. The two air freight companies have four and six DC-6As respectively. The new contracts, which are in addition to present contracts covering PAC's overhaul of the airlines' DC-4 R-2000 powerplants, will result in a 50% increase in the work load at PAC's Burbank, Calif., engine overhaul shop.



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H-21 loading troops (right) later lands on valley floor in Aures Mountain region. Rugged terrain of operations is indicated.

Special Report from Algeria, Part III:

Maintenance Plagues Fine Army Base

By Robert Farrell

Setif, Algeria—Obviously a good deal more money has been spent by the French Army for its main helicopter base at Setif than the French Air Force has spent at Boufarik. A visitor arriving from the Air Force base can't help but be impressed by Setif. But the Air Force seems to be doing a better maintenance job with a lot less equipment.

Setif is located at an altitude of 3,000 ft. atop the lush plateau of Eastern Algeria. Surrounded by vast wheat fields and Roman ruins, the terrain and climate are somewhat similar to that of the American Midwest.

Army Purchase

The Army helicopter group has been in operation here for 15 months, ever since it bought the Setif air base from the French Air Force. Commanded by a colorful ex-racecar driver and Indo-China veteran, Major Crespin, Setif is the Army's only operating helicopter group other than a small training school in France.

Setif went into operation with three Bell 47G-2s and two Sikorsky S-55s. Three months ago it had 12 Bells and seven S-55s. Since then deliveries have been stepped up sharply, including the direct shipment from the United States to Setif of the Army's first batch of Vertol H-21 Work Horses. The present Army equipment being flown at Setif is as follows:

Twenty-one Bell 47G-2s built by the Milanese firm of Agusta; seven Westland Whirlwinds, built under Sikorsky license and powered by a 600 hp. Pratt & Whitney 1340 engine; seven early model S-55s, also a 600 hp. Pratt & Whitney; six S-55s type H-19D3, pow-

H-21 touching down with left main gear, which isn't fully compressed.

VERTOL H-21s for French Army at Setif are flown off French carrier at Algiers.

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ered by 800 hp. Wright R1300-3 engine, and, finally, 11 Vertol H-21 Work Horses.

Present Strength

In addition to the Army's Vertols, the French Navy is operating three H-21s at Setif. Two Work Horses—one Army and one Navy—recently were knocked out by crashes. Thus, the total number of operating craft at Setif is 53, including 12 H-21s.

At Setif each type of helicopter makes up a squadron, except for the Bells which are broken up into three squadrons of seven each. Also, the Navy, though working under Army command at Setif, operates its Work Horses as a separate squadron.

As at the Air Force helicopter base at Boufarik, the Setif squadrons usually are assigned to work with Army ground units on missions which last from three to four days. Setif is concerned mainly with eastern Algeria. Air Force helicopters operating out of Boufarik take care of western Algeria.

Since its beginning in the late spring of 1955, the official record of the Army Setif helicopter group is as follows (figures go up to August 15):

- Operational missions....20,616
- Total hours flown.....17,308
- Troops transported.....32,915
- Personnel transported, non-combat 7,995
- Wounded evacuated.... 3,131
- Freight carried .....377,670 kilograms

July Operations

Like the Air Force at Boufarik, the Army has been operating at its present strength only for a few months. Thus a look at July operations gives a better picture of current activity. Records at Setif break down the activity for each type of craft as follows:

• **Bells.** Twenty-one operated 1,344 missions, mostly evacuation of wounded and carrying of supplies to small outposts. According to Setif officers, Bells are being used more and more as aerial command posts. Ground commanders, after ordering troop dispositions, like to go aloft and see if orders are being followed. Occasionally troops have been maneuvered by ground officers flying over the skirmish area in a Bell aerial command post. Once the battle is over the Bell reverts to its usual role of evacuating wounded.

• **Westlands.** Seven carried out 275 missions in July. The Westland, according to Army officials here, isn't much good except for sea-level work. Used infrequently for combat operations, it usually hauls personnel and supplies.

• **Sikorsky S-55s.** Thirteen, including both earlier and later models, operated 582 missions in July. In general, only the H-19D3s are used in combat troop

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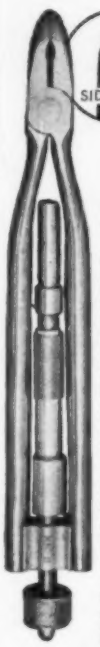

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operations. The earlier model doesn't carry its load as well at higher altitudes, where much of the fighting takes place.

• **Vertol H-21s.** These new ships are just being worked into regular operations by the Army. In the last 10 days of July, 40 missions, mostly troop carrying operations, were carried out. From Aug. 1-15, four H-21s went out on 250 missions and carried a total of 2,000 commandos.

Army says its H21s are carrying from 8 to 14 fully equipped troops plus a crew of three, with 12 as the average. This figure is expected to rise as crews become more familiar with operating at peak loads. Naturally temperature and altitude are the determining load factors. H-21s, according to the official Setif record, have carried and disembarked as many as 10 commandos while operating in mountainous regions as high as 6,000 ft.

Training & Losses

Many of the Army pilots at Setif have been trained on helicopters in the U. S. A good portion flew helicopters in Indo-China. At Setif, pilots are logging an average of 50 hr. a month. Some have hit 90 hr. in a busy month, despite the official 80-hr. limitation. Since the H-21s came directly to Setif from the U. S. by carrier to Algiers, a good share of the H-21 squadron's activity is the training of air crews. The Army is being helped in this field, as in maintenance work, by four Vertol employes stationed at Setif.

Since the Setif operation began, the Army has lost seven helicopters. Five were Bells, including two knocked down by ground fire. The pilot of one of the latter was flying low when struck by a burst from an automatic weapon. Wounded seriously, he crash-landed and was shot by the rebels. The Bell's Legionnaire stretcher case was also shot and the second stretcher case, a sick soldier, was taken prisoner. The pilot was not wearing his flak vest, an oversight which Setif officers think cost him his life.

In addition to the five Bells, one early model S-55 crash-landed some months ago and burst into flames. The pilot was lost.

Crash Inquiries

Two H-21s recently crashed but no serious injuries resulted. Inquiries were made into both accidents immediately, and the following are the unofficial accident reports for each:

• **July 9,** during an evaluation mission southeast of Setif, a new Army H-21 was operating at a pressure altitude of 5,300 ft.

Temperature was 15C with no wind. In addition to pilot, copilot and crew chief, there were seven troopers aboard. At first landing attempt with estimated 12,450 lb. load, the pilot re-

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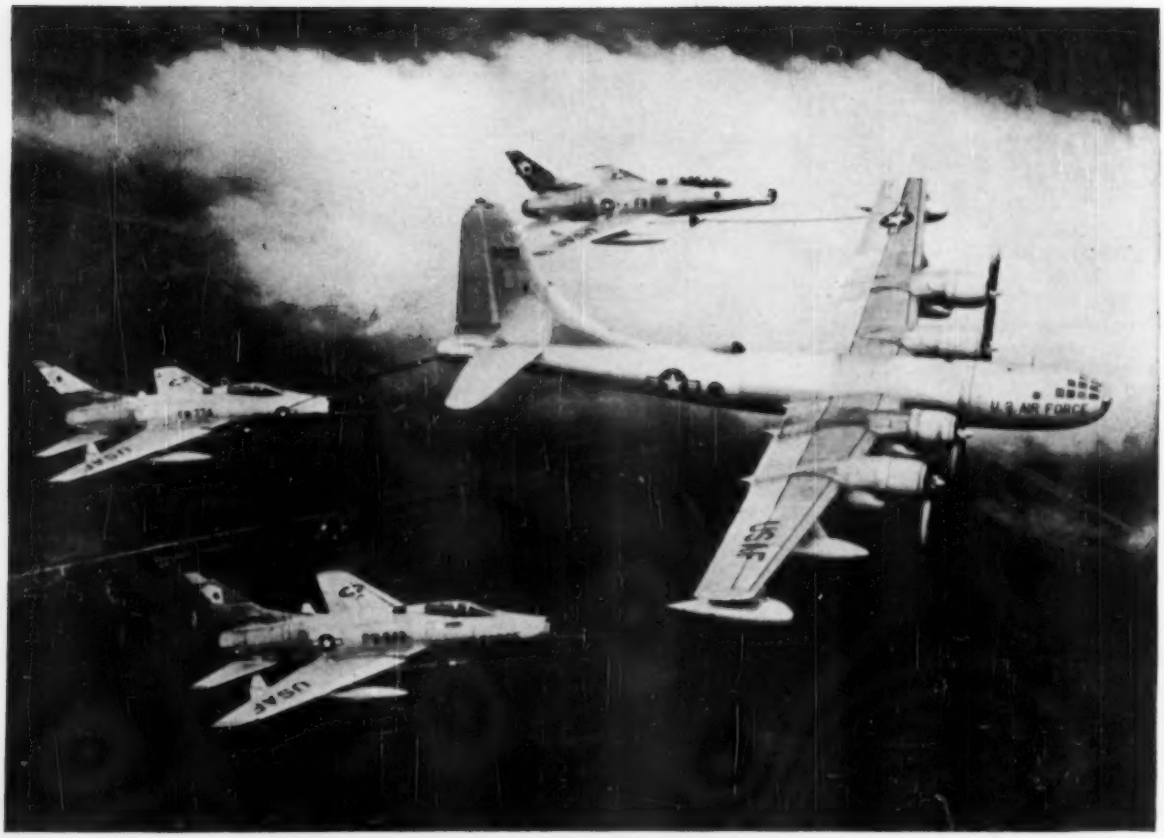

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ported insufficient hovering power, and returned to the valley floor to drop off the crew chief. Returning to the original landing spot, the pilot made a conventional approach in an area roughly 75 ft. x 50 ft. that was covered with scrub trees from 4 to 10 ft. high.

The pilot later claimed the H-21 settled to the ground with little forward speed, and at touchdown he heard a loud snap. Full throttle was employed and the H-21 responded in a gyrating fashion, clear of the ground, and then rolled on its right side. Thirty per cent of the H-21 was destroyed.

Too Fast

According to on-the-scene observers, and contrary to what the pilot said, the helicopter apparently came in for landing with too much forward speed. This theory was bolstered by the pattern of tree destruction in the landing path.

• **Second H-21** crash occurred during August to a Navy craft on a training mission eight miles from Setif. The helicopter had 30 hr.; the pilot, 28; the copilot, 30. Five passengers were aboard. The pilot claimed engine failure at 30 ft. altitude. Crashing, the ship lost its blades, rotor head and gear.

Initial Navy inquiry was held at Setif. Preliminary verdict was pilot error and not engine failure. Gas was found into the carburetor. The Navy felt the engine was in good operating condition at the time of the crash, and that its pilot got the mixture control switch confused with the carburetor air control.

Another case of "mistaken switches" was the third, though minor, H-21 accident at Setif. While practising the use of the H-21's belly cargo sling, an Army pilot flipped the gas cut-off switch instead of the cargo loading switch. The ship, dropping onto the cargo and ripping out its belly, was out of commission for a month. The two switches are located one atop the other on the right side of the overhead instrument panel. Since the accident the gas cut-off switch has been safetied down.

The French would like to see the switches relocated.

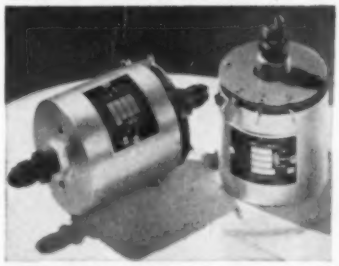
Maintenance Problems

One American technical visitor at Setif remarked that few helicopter installations in the States were as well-equipped as this one. Much of the equipment, it seems, came as part of a package deal when the Army ordered its Vertol Work Horses.

Yet closer examination also turned up faults. Army has a small nucleus of excellent helicopter mechanics, some of whom learned their business under fire in Indo-China. About 20 of the Army mechanics here underwent an intensive 30-day course at the Vertol plant in the U. S.

But too many budding mechanics

AIRCRAFT TRANSDUCERS



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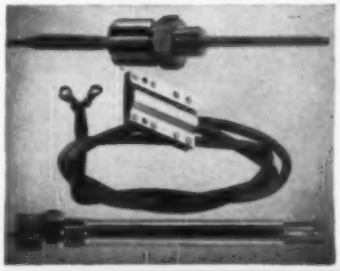

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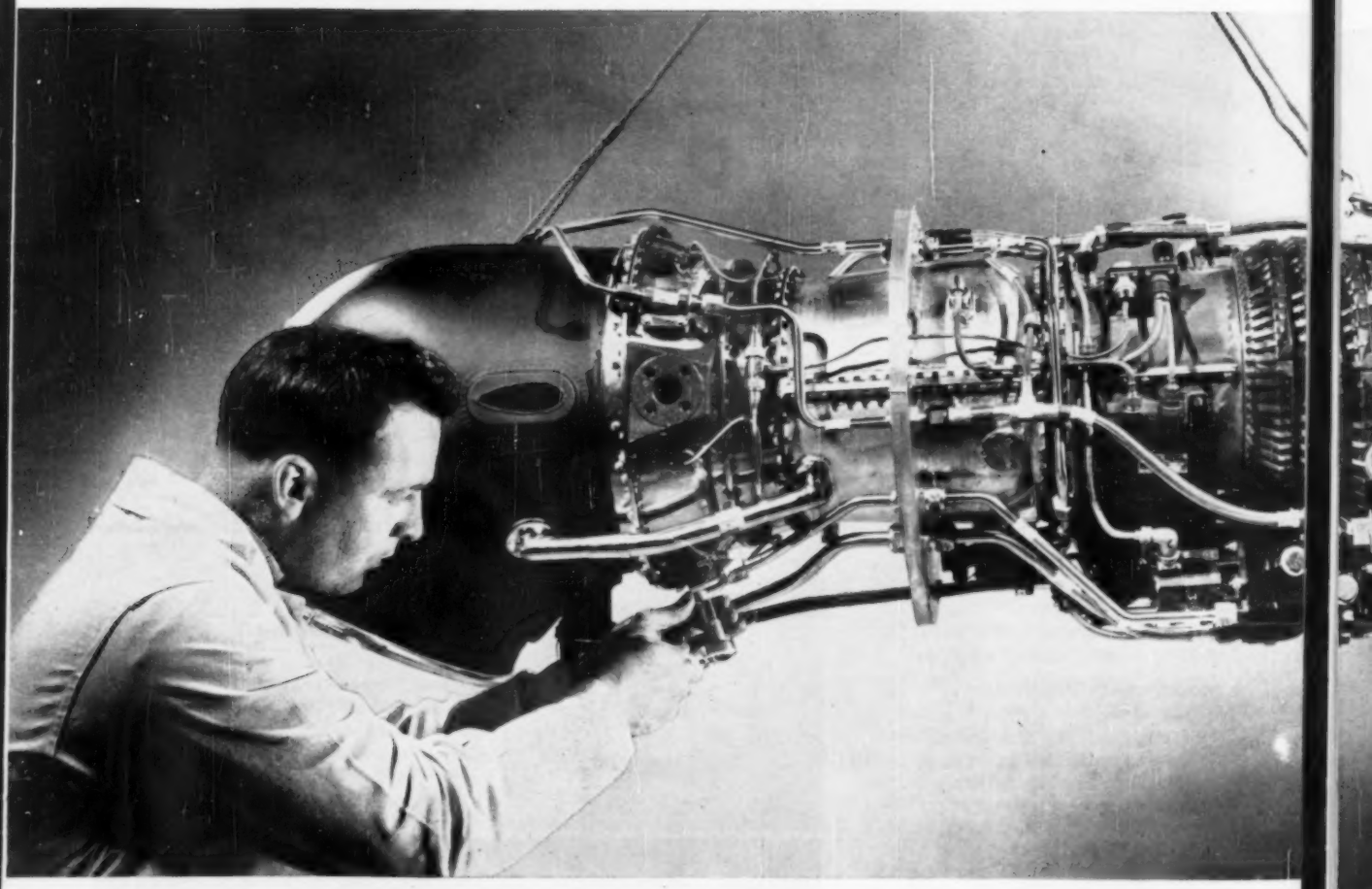

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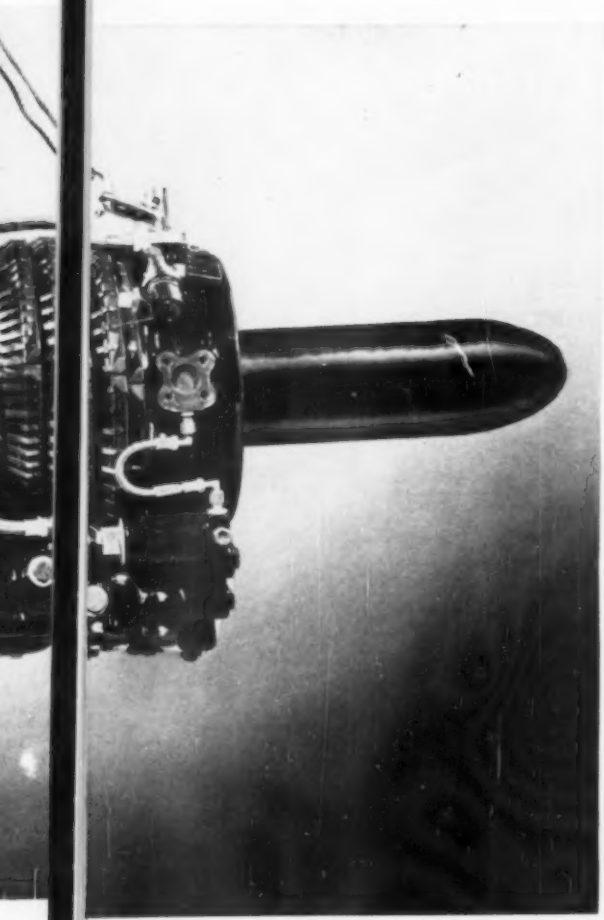

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All figures are based on engine without helicopter reduction gear. Gear weight: 75 lbs.

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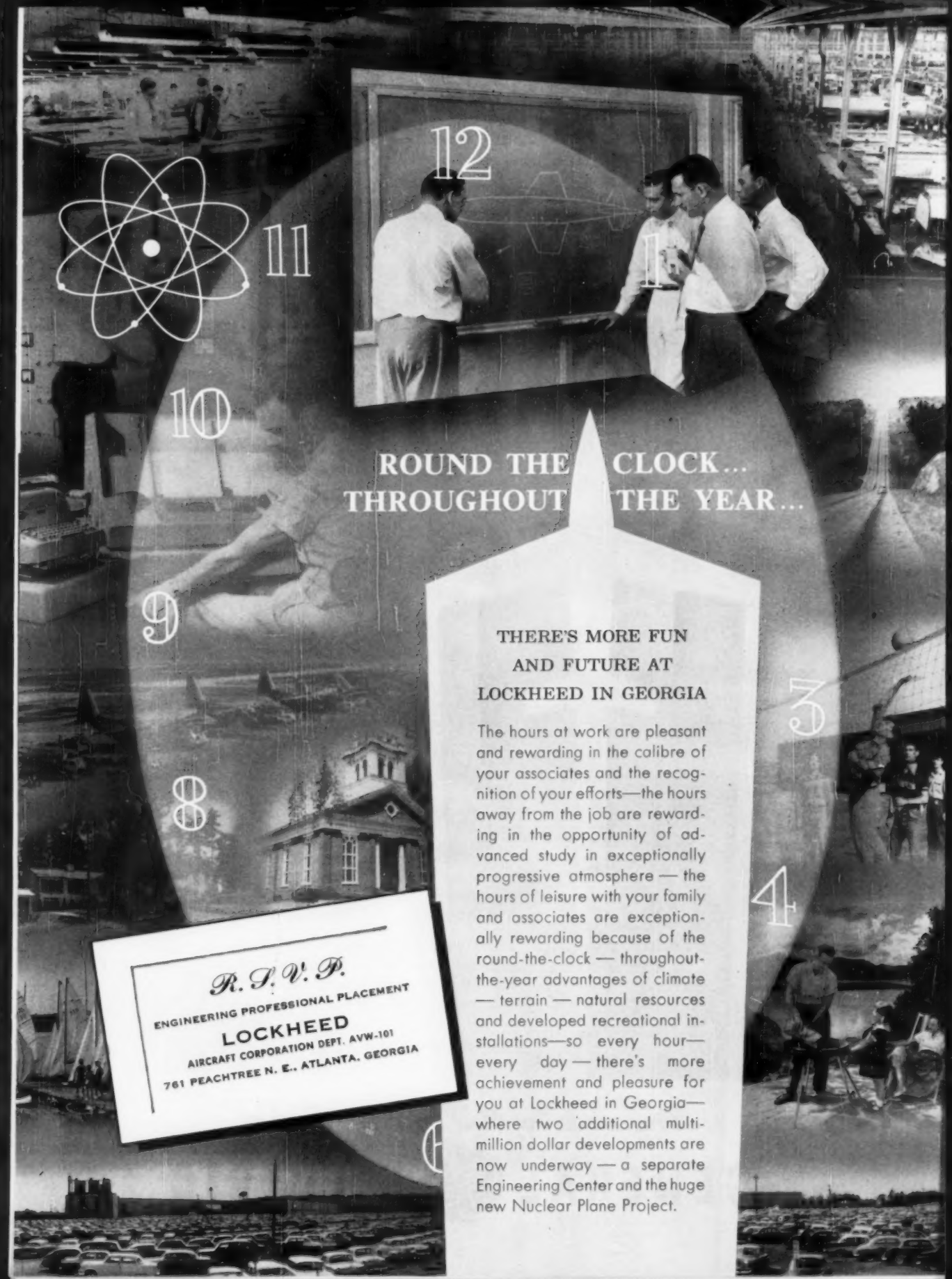
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here are not being trained as well as they could be. A great number seem to be employed as wipers, keeping the craft clean but not learning much.

For a set-up as well equipped as Setif, a visitor is surprised to find no metal section or engine division. In fact, there is very little specialization. In short, while the Army at Setif seems to be slowly feeling its way towards a more efficient maintenance system, it obviously hasn't as yet reached its goal.

Routine inspections often tend to tie up a H-21 for several days instead of one afternoon. Vertol representatives on the scene, working with some talented French officers, are doing their best to clear up the situation despite vexing language difficulties.

Utilization Hours

Outside of the H-21, however, the Army is keeping from 70-75% of its craft available. Utilization by hours, for the month of July, is as follows:

- **Bells,** 60 hr. average per ship.
- **Westlands,** 45 hr.
- **Sikorsky S-55** (Pratt & Whitney), 45 hr., (Wright), 54 hr.

Like the Air Force at Boufarik, Army technical officers at Setif say they haven't run into any special maintenance problems due to the climate or to the nature of their operations. That is, except for engine time. As at Boufarik, engines are often strained and have to be pulled ahead of conventional time.

Engine time on the H-21 is as yet insufficient for determining how well the powerplant will hold up. But the Work Horse is being pushed hard by French Army pilots.

Fighting Takeoff

A story is told at Setif about one H-21 which took off overloaded with the pilot pushing full throttle and the copilot firing his pistol out the cockpit window. This was the first H-21, incidentally, to be struck by rebel fire—a bullet hole being pierced above the main cabin door.

Technical officers at Setif say they are having no real trouble with blade erosion on the H-21. First six H-21s to be delivered to Setif had a special preventive stripping applied just behind the metal leading edge of each wooden blade.

This was done in anticipation of erosion. Yet the seventh H-21 to be delivered does not have the preventive covering, and technical people here say even the blades on this ship show no unusual signs of erosion. The French, however, would prefer metal blades to wooden ones.

Rotor-heads on the Work Horse are still serviceable at the 450-hr. mark, they add.

(This is the last of three articles.)

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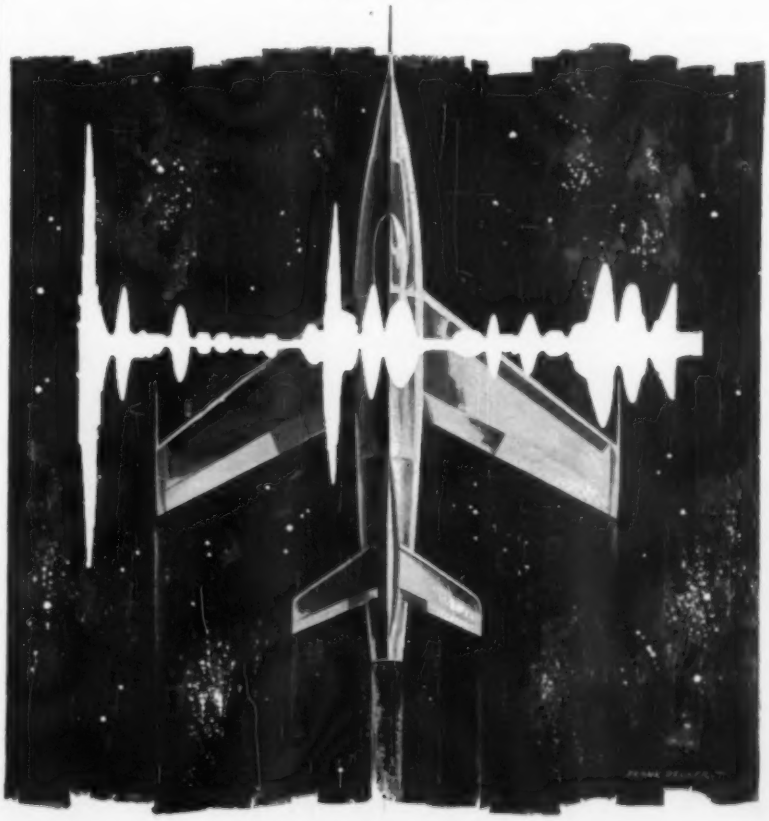

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Aviation Week Check Ride:

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By Richard Sweeney

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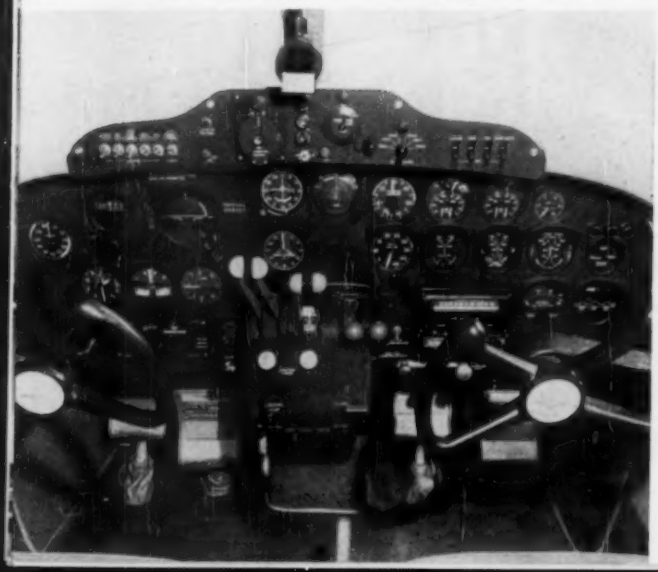
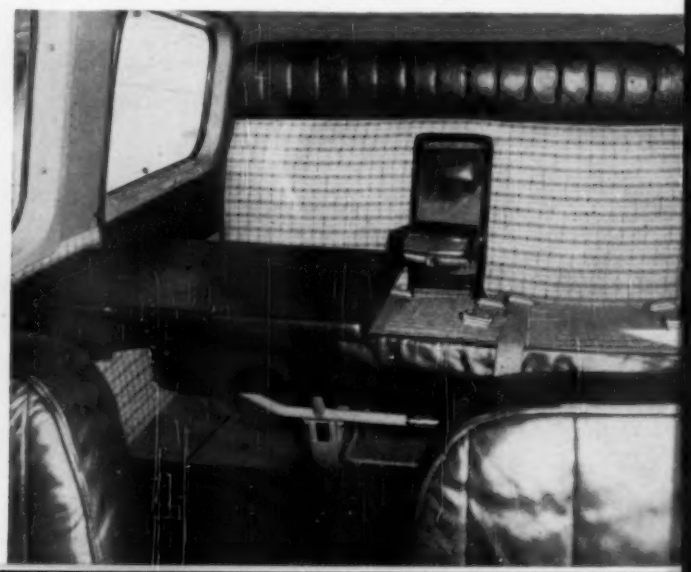
The 680's single engine performance, required by Civil Air Regulations since the airplane grosses more than 6,000 lb., is excellent. It exceeds requirements by a safe margin, although the airplane has a relatively high gross weight for its size, and, for its class, a heavier than usual wing loading of 29.2 lb./sq. ft.

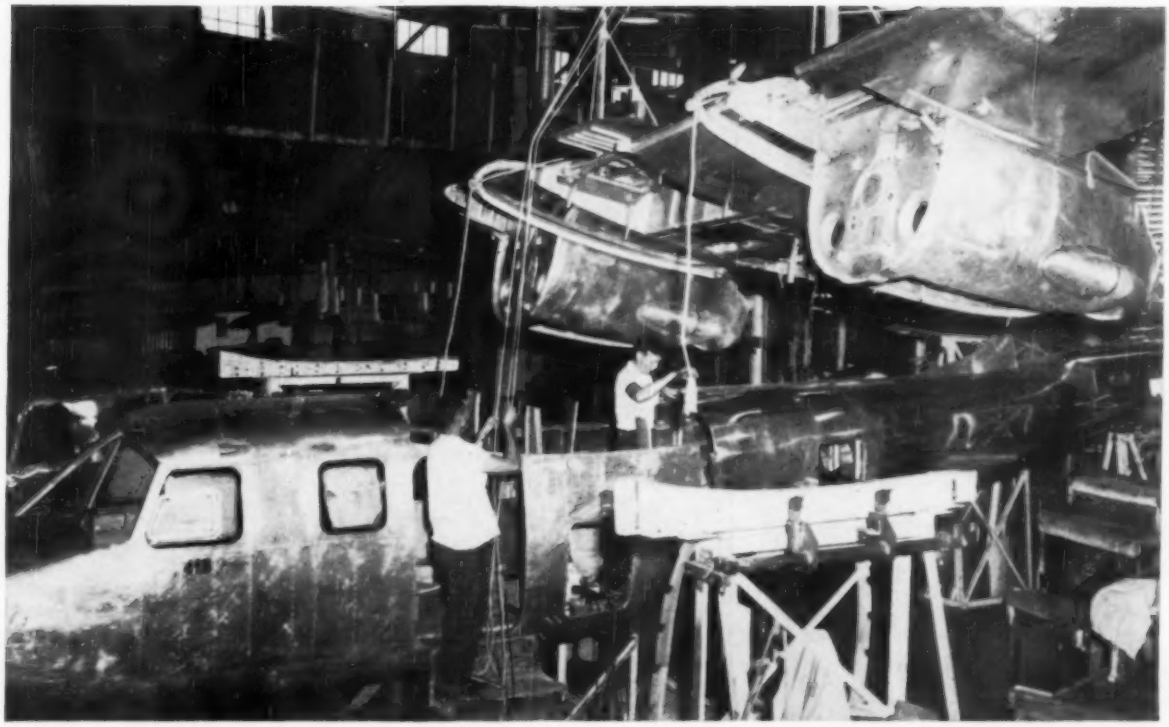
Aero Design was the first company to introduce three bladed propellers on light twin executive airplanes. Now Aero is adding another first—reversible propellers. Designed by Hartzell, they are currently mounted in a 560A test bed, with more than 25 hr. flight test behind them. Reversible propellers were added for several reasons: to obtain better control on icy, rainy or snow covered runways, to increase short field landing performance and to get better ground handling ability. The airplane can be backed up with the reversible propellers.

The reversing is electrically controlled, with switches mounted away from the quadrant pitch-feathering levers, and hydraulically operated by

DUAL CONTROLS are standard equipment. Rear seat (center pictures) can be tilted back for sleeping. Hinged table can be used as







COMPLETE WING, with engine nacelles, is lowered into fuselage cutout where center wing and skin will be permanently attached.

propeller governor accumulator pressure. Safety measures beyond the separate switch locations include dynamic balancing which makes it impossible for the props to reverse until they are unloaded to less than 80 mph. IAS. Approach speeds are 90 IAS for the Commander 560-A and 105 for the 680 Super, both well above the transition point. Blade reversing angle is - 25 deg., and the throttles are opened in the conventional manner to apply reverse power.

So far in the test program, the propellers have been operated in reverse pitch for as long as 15 min. at reasonable manifold pressures without engines overheating.

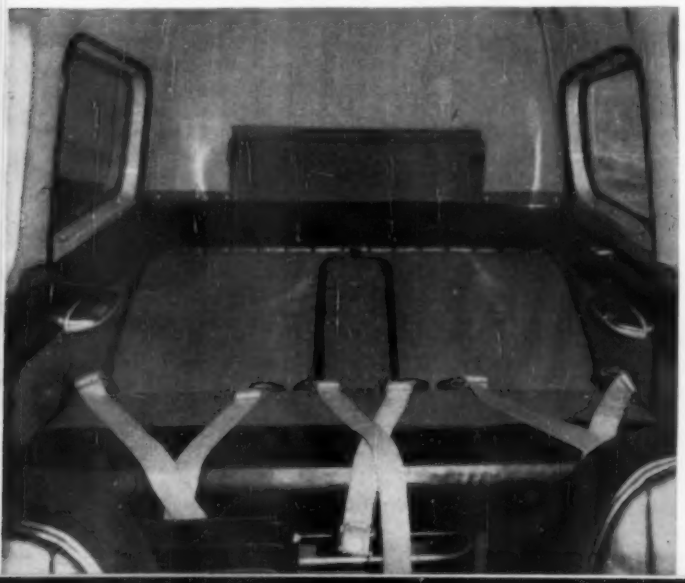
Reversible propellers will be optional equipment on both the 560-A and 680 Super when flight tests are completed and certification obtained. As yet, no prices have been determined, nor a target date set for their formal introduction.

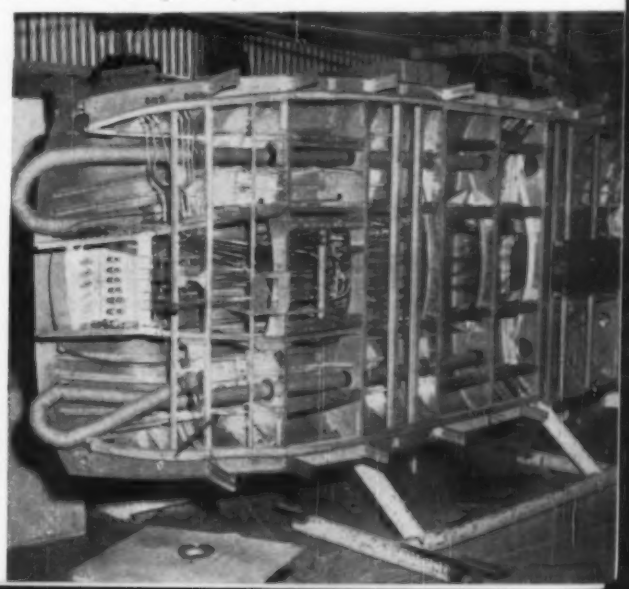
Easy to enter, the Aero Commander is a comfortable airplane. Cockpit layout makes it possible for a single pilot to operate the aircraft, but a copilot helps, especially in engine air starts.

Dual controls are standard equipment. Flight group instruments are in front of the pilot, navigation instruments centered above the pedestal, gages in front of the copilot (but still read easily by the pilot). The pedestal is simple—throttles, propeller controls and mixtures left to right, landing gear and flap operating handles below. To simplify operations at the pedestal further, the 680's Bendix carburetors include automatic leaning which eliminates mixture setting changes in flight.

Radio controls are mounted on their own panel above the regular instrument

desk. Bottom of fuselage (far right) is assembled in separate jig to simplify installation of wiring and hydraulics.





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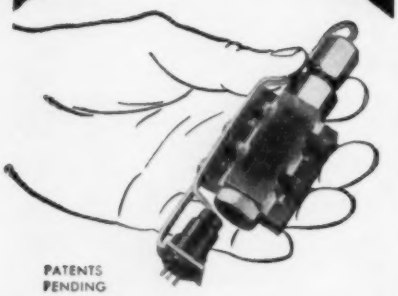

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Performance Data for 680 Super

High Speed–rated power—10,000 ft	260 mph
Cruising Speed—70% rated power @ 10,000 ft	230 mph
Cruising Speed—65% rated power @ 15,000 ft	230 mph
Stall Speed—gear and flaps down—power off	71 mph
Stall Speed—gear and flaps up—power off	79 mph
Gross Weight	7,000 lb
Empty Weight	4,330 lb
Range—with 30 min. reserve @ 10,000 ft. @ 55% rated power	1,480 mi
Range—maximum economy	1,600 mi
Fuel Capacity—total usable	223 gal
Service Ceiling—2 engines	24,200 ft
Single Engine Ceiling—feathered prop	15,000 ft
Rate of Climb—2 engines—S/L	1,600 ft/min
Rate of Climb—1 engine—S/L	310 ft/min
Take-off Distance to clear 50 ft. obstacle at S/L	1,575 ft
Landing Distance over 50 ft. obstacle at S/L	1,630 ft
Engine	Lycoming Supercharged GSO-480-A1A6 340 hp-take-off

(All performance is based on full gross weight and standard atmospheric conditions, unless otherwise stated. All speeds guaranteed within plus or minus 3%. All climbs, ranges and altitudes guaranteed within plus or minus 8%.)

DIMENSIONS

Cabin	
Height	53 in.
Width	52 in.
Distance forward cabin bulkhead to rear cabin bulkhead	127½ in.
Cu. ft. in this area	177
Baggage Compartment	
Length	31 in.
Width	47 in.
Height	41 in.
Cu. ft.	32
Cabin Door Opening	
Height	43 in.
Width	26 in.
Baggage Door Opening	
Height	23½ in.
Width	19½ in.
Airplane	
Height	14 ft. 9 in.
Length	35 ft. 5 in.
Span	44 ft. ¾ in.
Tread	12 ft. 11½ in.

panel for easy access in flight, with operating switches in front of the pilot, master switches in front of the copilot.

Master airplane electrical switches, engine switches, cabin, instrument and other light controls, circuit breakers and trim control wheels are mounted on the overhead panel. Trim wheels move clockwise for nose right, forward for nose down.

The pilots' seats slide in and out for access and adjustment to the controls, and the backs recline for long flight comfort. Each position has its own air conditioning controls. Main cabin air conditioning controls are in front of the copilot.

conditioning controls are in front of the overhead panel for outboard-to-inboard movement, from fuel selector (electrically operated tank valves) to boost pump to primer to starter button. At the far left on the pilot's side of the overhead panel, master airplane electrical switches turn on in a left-to-right sequence. Since firing impulse during starting is delivered to the left magneto, engines are started on left only, the switch moved to both as the engine fires. Other starting settings are fuel boost on, throttles slightly open and mixtures in idle cutoff, moved to full forward as the engine catches.

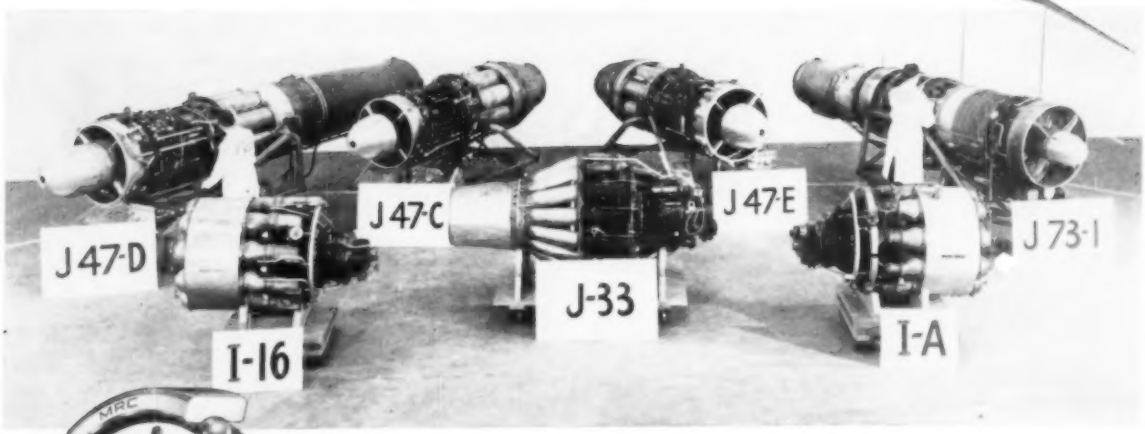
Since the hydraulic pump is on the left engine, this is usually started first. The airplane carries dual generators and vacuum pumps for flight instruments.

Like all airplanes, the Commander 680 has its individualities, and ground handling and taxi is one. At first, the hydraulically steered nosewheel gives the impression of free travel, but use of nosewheel and engines for taxi with little brake is a technique acquired quickly. The combination of high idling speed for the supercharged engines, good visibility and ease of ground handling result in the 680 usually being taxied faster than normal. Brakes are used extensively only in congested conditions.

There are no unusual checks or con-

M-R-C

from the FIRST to the LATEST and into the FUTURE in *TURBOJET ENGINES*



M-R-C experience in the design and manufacture of bearings used in General Electric jet engines, beginning 15 years ago with I-A, America's first jet engine, extends through the powerful J-79 (not shown).

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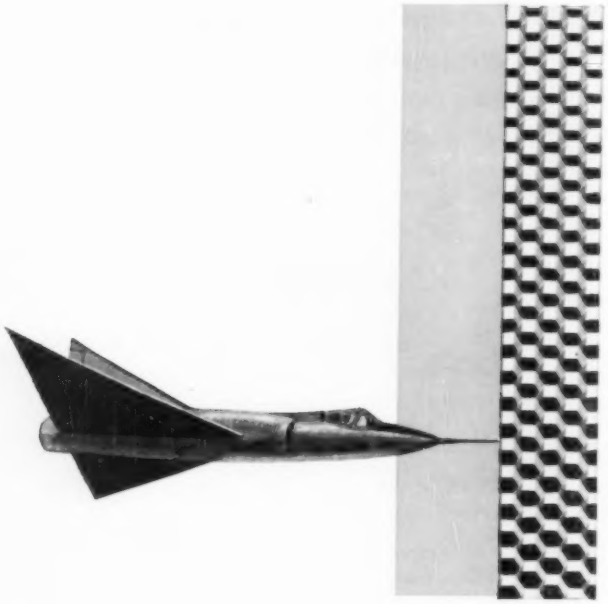
ICARUS never had a chance!



A "thermal barrier" ended Icarus' fabled flight when his beeswax and feather wings melted in the Mediterranean sun.

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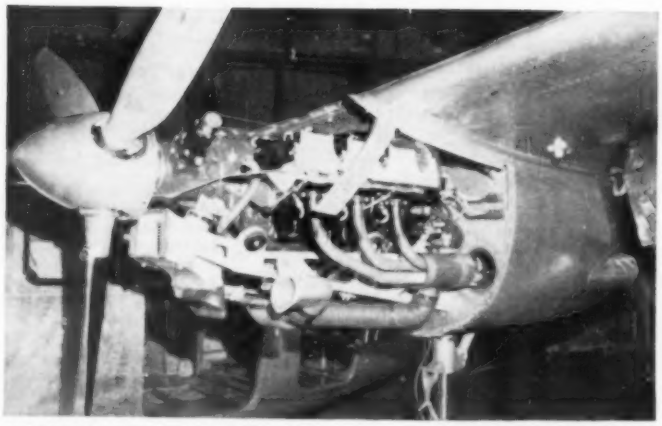

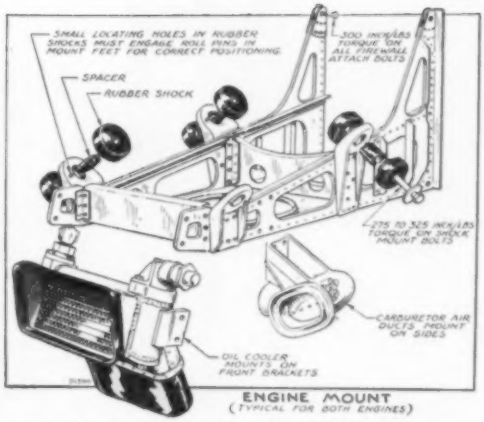
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ENGINE MOUNT
(TYPICAL FOR BOTH ENGINES)

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trols during Commander runup. A standard "left to right" cockpit check if a check list is unavailable, will cover all necessities.

Normally the airplane takes off with one-quarter flaps down to keep the climb angle within reason for those in the rear of the cabin. Climb angle without flaps at METO power is not too noticeable to the pilots, but it appears steep to those in back seat.

Extreme care must be used in applying takeoff power. Propeller governors will hold rpm. to the 3,400 maximum, but with superchargers, manifold pressures can be applied which will blow the heads off.

Redline manifold pressure is 48 in., and must be manually set. No mechanical stops are used, and pilots used to watching the runway while advancing throttles all the way forward at takeoff must change their habit here. Installation of mechanical stops which can be bypassed when throttles are safely advanced at altitude, have been considered by the factory, but not yet installed as production equipment.

The aircraft used in the flight evaluation was N6866S, a factory demonstrator. Company pilot aboard was Dale Ropp, factory sales representative. The aircraft was equipped with the company's optional group AD-1 of radio-navigation gear, consisting of Lear LVTR-36 transceiver, ARC 15-D omni navigation receiver, Lear ADF-14 radio compass, Flite-Tronics MB-3 marker beacon receiver, R89B glide slope receiver and Narco VTR-1 Omnigator, for a total weight including wiring of 152.1 lb. Standard dry weight of the aircraft was 4,425 lb., and with 1,138 lb. for a full 223 gal. fuel load, plus the navigation gear, the airplane went out at a gross of approximately 6,175 lb.

Equalizing Temperatures

Although the airplane was almost 1,000 lb. below maximum gross weight, temperatures in the Oklahoma City-Dallas area where the evaluation was made, tended to equalize the conditions toward standard day performance.

Flight evaluation included a cross-country from Oklahoma City to Dallas and Ft. Worth, during which a climb to 25,500 ft. true altitude was carried out and cruise conditions evaluated en route during climb and level flight. From Ft. Worth to Oklahoma City, single and multi engine stalls in various configurations and at various power settings were done. Short field performance was tested from the grass strip at Cimarron airport, near Oklahoma City.

Single engine go-around was performed with the left engine feathered on final approach, and 2,000 ft. pressure altitude used as ground level.

Stall recovery included nose well down, and nose to the horizon plus power application techniques.

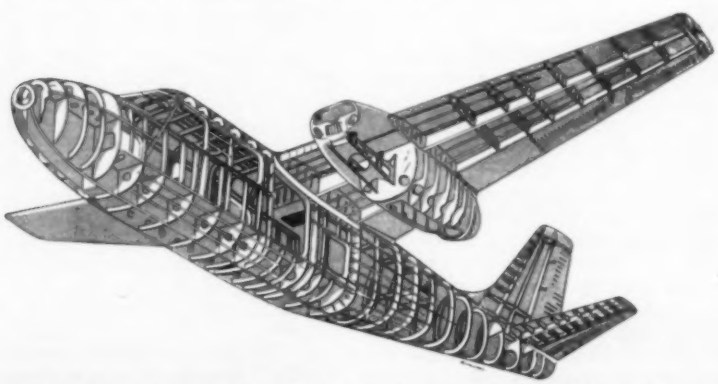
In all evaluation maneuvers, the airplane exceeded or equaled company figures for stall speeds, cruise speeds, fuel consumption, rates of climb and altitude loss in stalls.

In takeoff, the nose normally is raised at 80 mph. IAS, and the airplane flown off with back pressure. The aircraft accelerates swiftly past minimum single engine control speed of 85 IAS. The company recommends 105 IAS as go-no-go speed, usually exceeded prior to or at lift-off.

No extreme trim changes are experienced as the airplane is cleaned up after takeoff, and initial climb is usually at METO (320 hp.), 45 in. MP and 3,200 rpm. For best climb angle, 130 IAS is used, for best climb speed, 150 IAS.

En route, climb-out can be either at METO power, high cruise (43 in. MP, 3,000 rpm, 280 hp.), or normal cruise (36 in. MP, 2,800 rpm, 240 hp.). In all cases, rate of climb stays above 1,000 fpm. up to at least 10,000 ft. with adherence to proper airspeeds.

In all flight conditions, rudder trim is extremely important. The 680's performance results in moderate to heavy control pressures, depending on airspeed, altitude, etc. Though the airplane's physical size remains that of the 560-A, engine power has been increased considerably, adding to torque; yet there is no lengthening in moment arm from control surface to neutral axis, giving the effect of shorter coupling. Small changes in airspeed or power setting call for yaw trim adjustments,



CLOSELY SPACED formers and stringers in fuselage typify Commander's rigid structure.

but there is much greater latitude in pitch trim adjustments.

In all cases, the airplane can be held by control pressures until proper trim adjustment is effected, although surface deflections will be high.

Fuel Tank Trim

The airplane has no aileron trim, but correction for a wing heavy feeling can be made by fuel management—using from the outboard tank on the heavy wing while the opposite engine feeds from the center main tank—until trim is adjusted.

Stall warning system is incorporated as standard equipment, and except for one case in the evaluation, the airplane gave ample stall warning in the form of buffet. Warning system gives its alarm by a horn. However, in the one case in which there was no buffet warning the horn did not sound either. This condition obtains with the airplane clean, right engine inoperative and a standard rate climbing turn to the right underway with power set at 2,600 rpm. and 33 in. MP on the operative engine. In this condition, the airflow pattern remains such near the right wingtip, where the warning system sensing is installed, that no disturbance is sensed until the airplane breaks in the stall at 70 mph. IAS. Fortunately this is well down in the airspeed range where pilots know the danger is clear.

For all other cases, the sequence of horn, buffet and stall is well spaced, with ample time for recovery after either of the first two. With power on, single or multi engine, the airplane must be worked into the break, a further safety feature inherent in the design.

In power-on stalls, the airplane gained altitude in all cases investigated except one, and in this, a return to altitude at start of the maneuver was recorded, an excellent margin of performance. In power-off stalls, maximum altitude loss using nose-way-down recovery technique was 100 ft. from start of the maneuver.

Single Engine Test

Single engine go-around was accomplished with slower than average corrections for the simulated emergency. Left engine was feathered 300 ft. above simulated ground level with flaps half down at approach IAS of 105 mph. To induce worse-than-average conditions, hydraulic pressure was bled off, necessitating raising the gear by hand pump. No trim correction was applied until after the gear was up and climb-out established.

At application of takeoff power to the operative engine, the airplane immediately established a rate of climb of slightly better than 300 fpm. as air-

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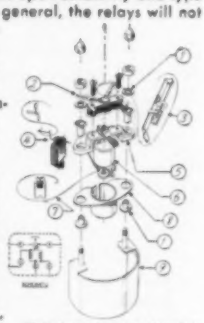

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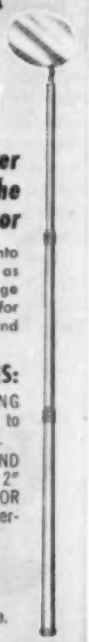
NO MATTER HOW YOU LOOK AT IT



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speed was increased to 130 IAS, and METO power set up on the operative engine.

The airplane held to its heading with high control surface deflection and heavy control forces. Care must be exercised while pumping the gear up to avoid getting the control column into phase with the pumping motion and setting up a heavy oscillation fore and aft.

As soon as the gear was retracted and the flaps allowed to blow up, the airplane established a rate of climb exceeding 500 fpm. at the same indicated airspeed. For best angle of climb in this situation, an airspeed of 110 is recommended.

During a simulated engine failure at cruise power and airspeed in the lower ranges, the airplane was held to its heading within five degrees using aileron alone, although extreme deflection was required.

Cruising Trim

Cruising, the airplane trims out extremely well for hands off flight, and the wing loading is such as to enhance stability when rough air is encountered. In maneuvers from cruise powers and airspeeds, high cruise, normal cruise and economy cruise, control forces were light in standard chandelles, lazy eights, etc., and stability was demonstrated by releasing the controls at various stages in the maneuvers.

At high altitudes, the airplane handled well, without any unexpected mushing tendency when greater than normal accelerations were induced.

True airspeeds of 232 and 218 mph. at power settings of 52% and 44% respectively were registered at 25,500 ft. true altitude.

For short field work, approaches are made at 85 IAS with power and full flaps down, props advanced to high rpm. Throttles are not cut until touchdown is assured. For short field takeoffs, standard one-quarter flaps are used, but the airplane is hauled off just past 80 mph. IAS. Cleaned up, airspeed is kept at 120 IAS and climb angle is held extremely high.

With the airplane at a gross weight approximating 5,500 lb. and an outside air temperature of better than 90F at a field elevation of 1,350 ft. above sea level, the airplane was landed and stopped within 450 ft. On takeoff, ground was broken in just slightly more than 500 ft., indicating extremely high performance is available in case of emergency, and bearing out company takeoff distances over a 50 ft. obstacle.

In simulated instrument flight, the airplane handles very well. Flight technique most appropriate is to let the airplane's inherent stability compensate for turbulence rather than try to fight rough air to a standstill. Stability

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Standard Kearfott servo motors and servo motor-generator combinations are now available for operation with transistorized amplifiers. These units feature center tapped control phase windings rated 40 volts in series and 20 volts in parallel. Fixed phase excitation to size 10 units is 26 volts 400 cps and to size 11, 15 and 18 motors 115 volts 400 cps.

SUMMARY OF CHARACTERISTICS

Size	Stall Torque	No Load Speed	Watts Phase	Weight
10	.28 oz. in.	6500 RPM	3.1	1.5 oz.
11	.63 oz. in.	6700 RPM	3.5	4.5 oz.
15	1.53 oz. in.	5300 PRM	6	7.30 oz.
18	2.4 oz. in.	5300 RPM	9	12.2 oz.

AMPLIFIERS

A new transistorized servo amplifier suitable for driving size 10 and 11 servo motors is also available. This amplifier provides a 40 volt, 3 watt output. Designed to meet the requirements of MIL-E-5400 it is rated for operation over the ambient temperature range of −54°C to +71°C. A servo type base and a cable with an SM11-20H connector is provided. Dimensions 1 42/64" dia. x 3 25/32" high, weight 8 ozs.

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at reduced airspeeds and powers approximating holding conditions was excellent. Smoothness in control movements help considerably in handling, but the airplane will withstand rough techniques without showing resentment.

Power-on approach, the normal light twin landing technique, is used. Again, the power is not to be removed until the landing is definitely committed, since the airplane will sink rapidly with props advanced, gear and flaps down. Cutting power at flareout produces the smoothest landings.

Pilots used to conventional gears in larger airplanes will find the Commander's ground attitude and nearness to the ground for landing can result in initial approaches on the order of stair steps until the feel for the airplane's differences is acquired.

Low-wing aircraft pilots who look into the direction of turn out of habit can lift a wing of the Commander on the side they intend to turn to make a visual check for traffic.

Pilot Adjustments

All in all, flying the Commander calls for adjustments in thinking to go with its different configuration. But they seem more than worth while in view of the airplane's qualities and characteristics.

Structurally, the airplane is conventional, with flush-riveted exterior and butt-jointed skin in certain high pressure areas. Skin thickness is determined by load carrying necessities.

Wing is of two spar construction with spanwise stiffeners, and built in two outboard sections and one center section. Flaps and ailerons are metal, beaded for stiffness, with a minimum of ribs. The same holds true of the tail group, beaded skin for stiffness and minimum ribs necessary to obtain aerodynamic shape.

Fuselage is semi-monocoque, built in two main sections, cabin and tailcone. In fabrication, the cabin floor is built first and has all necessary control cables and wiring installed before it is placed in the major assembly jig. Remainder of the cabin section is built up around it and the nose section installed. The tail section comes to the mating position minus vertical and horizontal fixed surfaces.

In the wing center section, the nacelles are fabricated integrally rather than as a power package. The engine mount at the firewall is attached to the front spar, with stressed skin carrying loads and transmitting them to the main wing structure. The engine mount itself consists of two forgings with built up sheet metal spacer structure along the bottom. The supercharged engine has been installed in the nacelle without altering it from its

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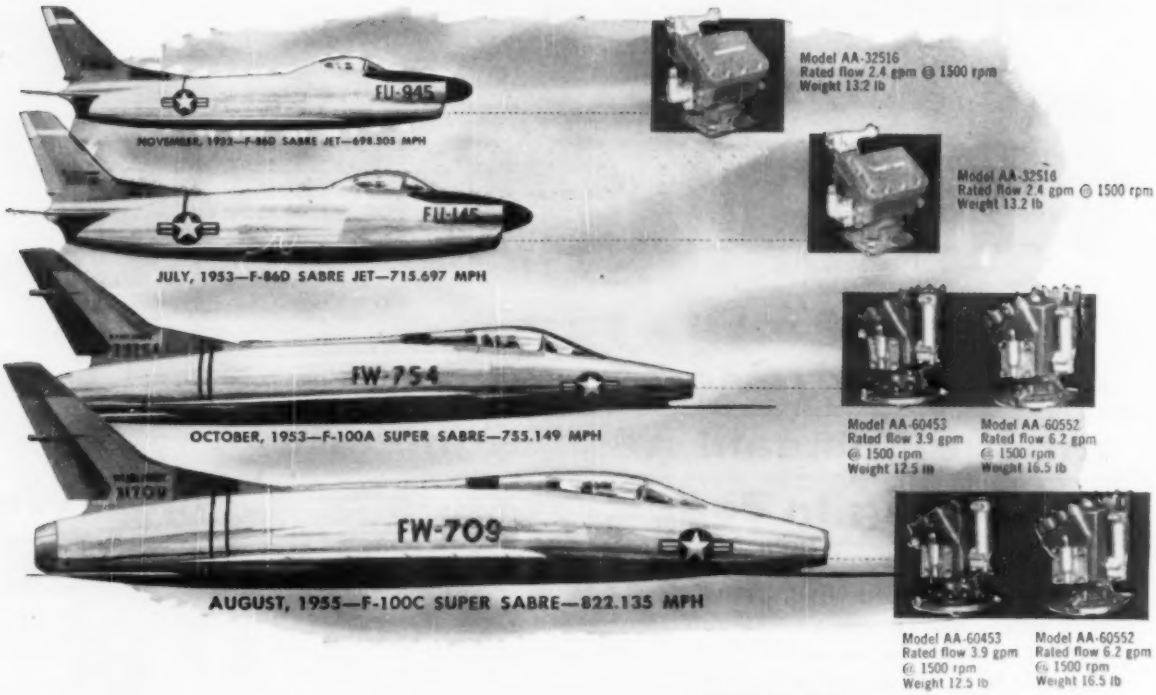

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outside configuration, the same as that of the 560-A. Augmentor tubes also are fabricated as an integral part of the nacelle-wing structure. The main landing gear is attached to the aft side of the front spar, and retracts backward, jackknifing into the nacelle.

Standard equipment on the airplane, which carries a basic price tag of $84,500, includes five-place seating, Scott "console" oxygen system, power nosewheel steering, built-in racks in the rear baggage compartment capable of accepting any of the optional equipments offered plus several additional items, a choice of four interiors, a hydraulic hand pump and emergency brake system, cabin heating and ventilating system, a full complement of interior and exterior lights, gear and flap position indicators, control lock, tow bar and emergency exit, as well as the full panel of flight and engine instruments, plus an electrically operated firewall shutoff system.

Extra Gear

Six groups of navigation and radio equipment are offered, ranging in price from $10,250 to $42,500. Basis of the equipments is the group installed on the demonstrator used in the evaluation, additions being the type necessary for overwater and foreign operations. Most expensive group includes dual Collins 360-channel communications equipment in addition to dual navigation equipment and a Collins Integrated Flight System.

Other optional items include a Lear L-2 autopilot, plus altitude control and approach coupler, Narco DME, Goodrich deicing equipment on wings, empennage and propellers, 75 amp. generators in place of the standard 50 amp. models, electrically operated flight instruments in place of the vacuum driven standard system. An interior extra is a hassock-chair which can be extended to make a bed, and inside contains either an icebox or chemical toilet.

Indicative of the use to which Commanders are being put today, almost all airplanes go out the factory door worth more than $100,000, or with more than $15,000 worth of optional equipment. In most cases the cost is in navigation and radio equipment, although some airplanes include costly plush interiors.

The airplane currently is built in a factory with a main single bay 100 x 200 ft. Lean-to structures are attached for special fabrication, material receiving and storage, and office and plant engineering staffs.

In production, the airplanes travel a U-shaped course through the plant. Small subassemblies are fabricated on second floor sections and lowered to the ground at their proper location.

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3	2"	11S3	36SR3
4	2"	11S4	36SR4
5	3"	10S5	37SR5
6	3"	10S6	37SR6
8	3"	10S8	37SR8
9	3"	10S9	37SR9
10	3"	10S10	37SR10
12	3"	10S12	37SR12
16	3"	10S16	37SR16
18	3"	10S18	37SR18
20	3"	10S20	37SR20
24	4"	27S24B2	38SR24
28	4"	27S28B4	38SR28
40	4"	38S2C	

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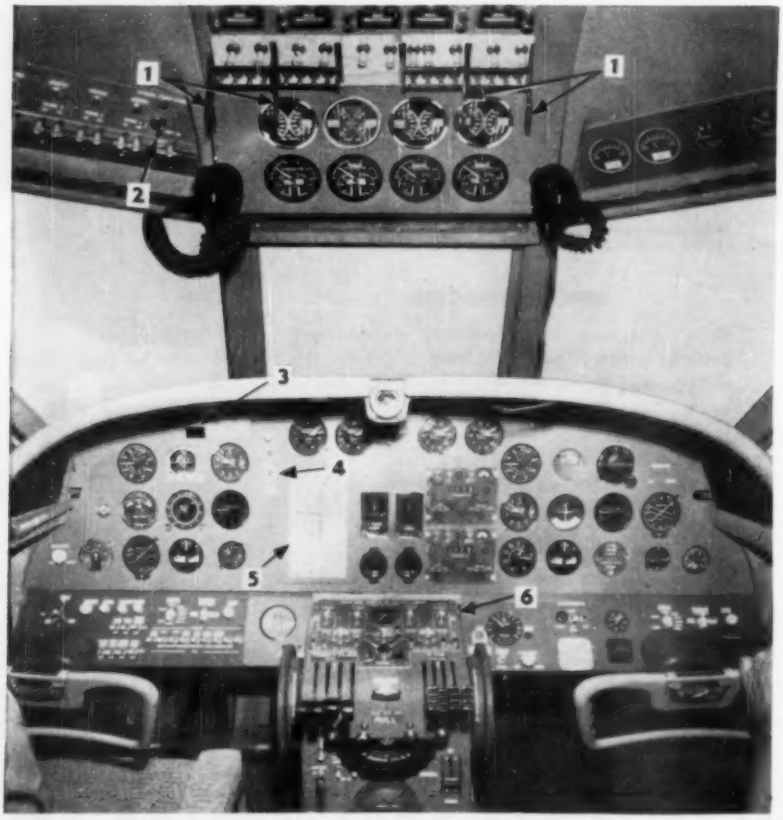
ROOMY FUSELAGE of Cessna 620 has cabin interior six-feet high; a rectangular floor plan allows wide variety of seat layouts.

Cessna 620 Design Blends Proven and New



COCKPIT (mockup) is laid out for one-man operation with all possible distractions suppressed: 1. single-throw levers secure engines in emergency; 2. magneto switches can be key-locked; 3. emergency warning light; 4. marker beacon display; 5. approach chart, flanked by flight instruments (left) and radio; 6. detailed fuel schematic with totalizer.

By Erwin J. Bulban

Wichita—Dovetailing requirements for a major breakthrough in multi-engine business plane performance with proven reliability of current large though obsolete aircraft set the pace for the basic layout of the new Cessna 620, Ralph Harmon, chief project engineer, told AVIATION WEEK.

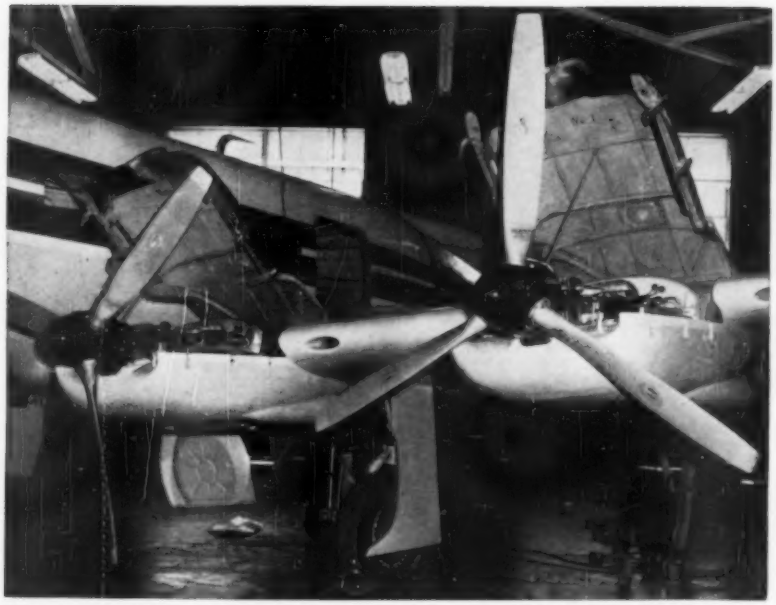
The pattern of using proven equipment and structural ideas predominates in the airplane. Its distinctive features are concepts that blend these components to produce a modern design requiring a minimum of ground servicing facilities.

Cessna recently announced that it has started taking orders for its Model 620 at a price of $375,000, with production beginning in early 1958 (AW Sept. 24, p. 32).

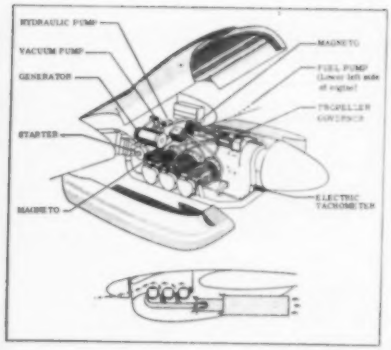
Talent Windfall

In the Model 620, Cessna followed its practice of setting up a completely separate engineering staff, with Harmon as project leader reporting directly to top management. Harmon supervises 105 engineers on the project, many of them non-citizens comprising 15 nationalities. Use of non-citizens provided the project with a windfall of high-level talent that would have been otherwise unobtainable in today's tight professional market, he noted.

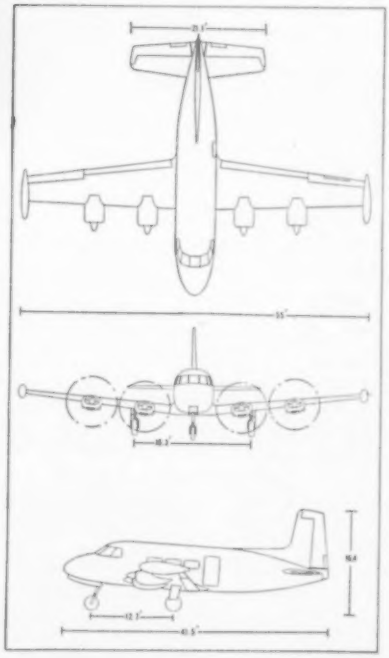
Engineering conferences on powerplant layout and selection invariably led to a four-engine configuration due to



ENGINE POSITION, petal cowls allow accessories to be checked without using ladders.



CONTINENTAL tailored accessories arrangement to 620. Dual-pump-type exhaust augmentor saves space over standard type.

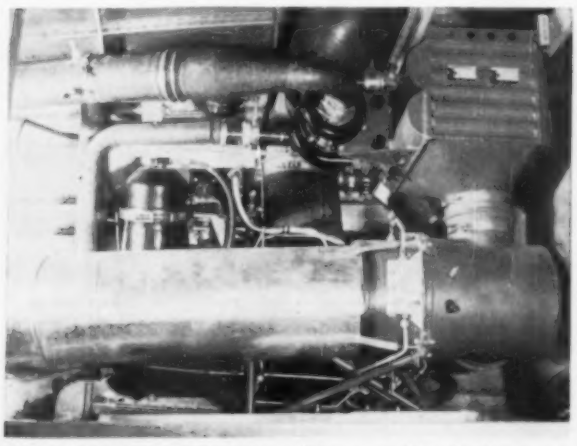


the increased engine-out safety factor compared to the twin layout, particularly in overwater flights.

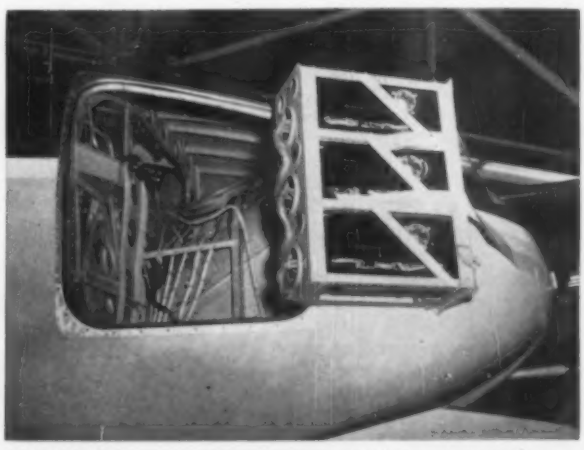
Decision to go to flat engines was based on Cessna's feeling that they have a long productive life with considerable development stretch, whereas small radials appeared to have ceased growing. Indications are that the company has designed the Model 620 with fuselage and powerplant stretch capabilities that have characterized the famed Douglas and Lockheed airliner series. Engineering thinking seems to be that the 620 basic design is good for at least 10 years, with its fuselage getting longer and more powerful engines being installed. Small turboprops, when they become available in quantity, can be accommodated.

Continental worked closely with Cessna engineers and spent considerable private funds fitting the 350-hp. GSO526-A to the 620, tailoring accessory placement to provide easy access without the need for using ladders, and at the same time keeping frontal area small. Propeller shaft is raised five inches above the main shaft to allow the nacelles to fit flush with the wings, cutting drag and permitting Cessna to design a landing gear that gives 13.34-in. ground clearance at the inboard engines for the 93-in.-diameter three-blade feathering Hartzell propellers.

Each six-cylinder powerplant has two exhaust augmentors with titanium tubes to provide efficient cooling without the need for cowl flaps. Augmentors are of a two-stage pump design which makes them approximately 25% shorter than a one-stage type would have to be to



GAS TURBINE pressurizes, air-conditions, provides electric power.



GENERATORS swing out to give access to instrument panel.

Cessna 620 Specifications

Span	55 ft.
Length	41.55 ft.
Height overall	16.65 ft.
Fuselage width	74 in.
Fuselage height	84 in.
Wings	
Wing area (gross)	340 sq. ft.
Wing flaps	48.4 sq. ft.
Ailerons	21.8 sq. ft.
Taper ratio	0.44
Dihedral	6 deg. 30 min.
Sweepback	zero
M. A. C.	79.033 in.
Aspect ratio	9
Tail	
Horizontal tail span	21.2 ft.
Horizontal tail area	100 sq. ft.
Elevator area	27 sq. ft.
Elevator tab area	2.14 sq. ft.
Elevator balance area	1.53 sq. ft.
Elevator travel	+28 deg., − 20 deg.
Elevator tab travel	±23 deg.
Stabilizer area	71.5 sq. ft.
Vertical tail span	107 in.
Vertical tail area	48 sq. ft.
Rudder area	18.9 sq. ft.
Rudder balance area	2.1 sq. ft.
Fin area	25.3 sq. ft.
Dorsal fin area	9 sq. ft.
Weights	
Takeoff gross weight	15,000 lb.
Landing gross weight	14,285 lb.
Empty weight (estimated)	10,000 lb.
Wing loading	44.1 lb./sq. ft.
Power loading	10.7 lb./hp.
Performance (estimated)	
Top speed @ 15,000 ft	282 mph.
Maximum cruise speed @ 2,600 rpm. @ 12,500 ft	260 mph.
Maximum rate of climb @ sea level @ gross weight	1,150 fpm.
Maximum rate of climb @ sea level @ 13,000 lb	1,520 fpm.
Takeoff distance over 50-ft. obstacle (sea level) at gross weight, one engine out at V_1	3,750 ft.
Landing distance over 50-ft. obstacle (sea level) @ landing gross weight, 14,285 lb	3,050 ft.
Maximum range @ 15,000 ft. @ optimum power	1,700 mi.
Endurance @ 55% power	9 hr.
Four-engine C.A.R. operational ceiling	25,000 ft.
Three-engine service ceiling	20,000 ft.

gain the same efficiencies. Temperature distribution between cylinder heads shows only about 45-deg. difference, Harmon noted. Bendix-Stromberg PS-7C carburetors with automatic mixture controls are fitted. Each engine has a 50-amp., 24-v. generator; two vacuum pumps are installed, on No. 2 and No. 4 engines. Edison continuous fire detection equipment is installed on all engines. Kidde two-shot, high-rate discharge fire extinguishing system has two 386-cu.-in. bottles located in the right wing fillet.

Fuel arrangement comprises a total of 535 gal., located outboard of the inboard engines between the spars and in tip tanks. Bladder-type cells are grouped basically to provide four tanks, one for each engine, with transfer system. Inboard tank consists of two cells totaling 135 gal.; the outboard tankage comprises three cells with 133 gal. Outer and tip tanks are interconnected.

Pressurized Fuselage

The 620 cabin is 6 ft. high by 13 ft. 3 in. long by 5 ft. 8 in. wide, with a rectangular floor plan to allow a wide variety of seat arrangements. Seat tracks run the entire length of the cabin, including the 50-cu.-ft. baggage compartment, with tiedowns in one-inch increments.

Seats and surrounding structure are built to take 10G acceleration. Weight distribution of the airplane puts 62% of the 620's gross load below the nine passengers and two crew-members.

Baggage compartment has a capacity of 500 lb. On the left side of the fuselage, behind the entrance is a lavatory. The airstair door, fitted with fixed mockup steps on the prototype presently, will have retractable steps so that the door takes a minimum of space when retracted. A continuous hinge along the bottom and six latches secure the door; fasteners are designed so that the door cannot open inadvertently when cabin pressure is on, Harmon stated.

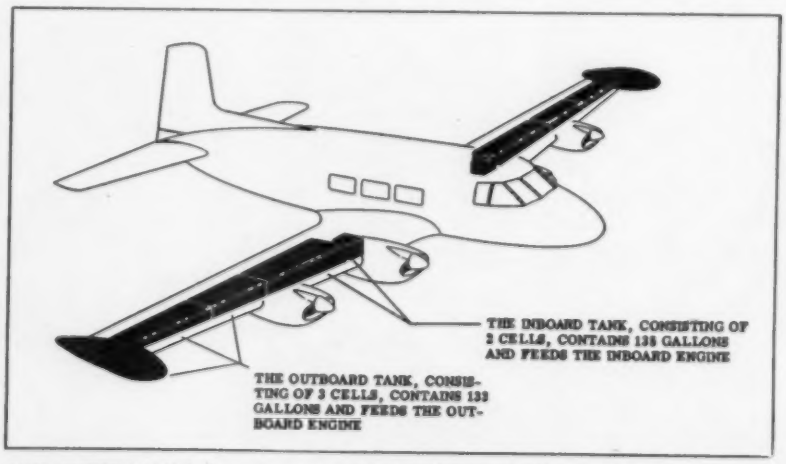
Cabin pressurization system will provide the equivalent of 8,000-ft. atmosphere when the airplane is at 18,000 ft.

Cessna did considerable research on maintaining cabin integrity and preventing a blowout. The company built a specimen eight-foot section of the cabin complete with windows, encased it in an airtight box, which was evacuated of air to test the fuselage structure and windows. Structure is designed to maintain stresses below the 12,000-14,000-psi. range. Extra metal reinforcements beef-up all cabin cut-outs such as door and windows. Every bulkhead and stringer in the fuselage meets the fuselage skin, which is fastened in small panels, providing numerous structural dams to prevent catastrophic ripping open of the cabin as happened to the de Havilland Comet. Most fuselage skin is 24ST .032; in the propeller plane there is heavier skinning, about .072, to provide stronger structure due to propeller harmonics and also to aid soundproofing. The fuselage is built in three sections: cockpit area, passenger cabin to the pressure bulkhead, and tail. The three are then permanently riveted together.

Windows are safety glass with vinyl cores having metal reinforced edge attachments bonded to the fuselage structure. Strength of this layout was inadvertently tested, when a workman accidentally struck one of the windows in the fuselage test section with a tool. When pressure was applied, the glass crazed, but has withstood all pressure tests. Should both windows break, the vinyl will tend to balloon out, but will act as a diaphragm to maintain pressure, Harmon said. Two rear windows are emergency exits.

The specially designed AiResearch gas turbine supplying cabin pressure is located behind the baggage compartment, separated by a reinforced plastic dome-bulkhead pressure seal. The turbine is fed from the main fuel system by means of a vapor-tight line that is carried externally on the right side to clear the cabin area. Fuel consumption is 6-12 gph.

The turbine also heats, cools and ven-


THE INBOARD TANK, CONSISTING OF 2 CELLS, CONTAINS 135 GALLONS AND FEEDS THE INBOARD ENGINE
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tilates the airplane in the air or on the ground and fitted with a 50-amp. 24-v. generator, provides electrical power to make the 620 independent of external ground power sources. Major components received 100 hr. of hard tests before Cessna received the unit and the airframe manufacturer reports that it has run it 30 hr. without malfunction. To increase the safety factor, it has been derated from about 105 hp. to 55 hp., turbine speeds were lessened considerably and operating temperatures were lowered about 150 deg.

Although the turbine area is not classified as a fire zone, with concurrence of Civil Aeronautics Administration, Cessna installed fire detection and extinguisher systems in this compartment. In addition the turbine is designed fail-safe. Seven different controls will shut it off in event of malfunctions. Additionally, the casing will contain the unit's rotating sections even in event of a major failure, Harmon said.

Flight Deck

The 620's flight deck has been human-engineered to group instruments and controls functionally, removing all distracting buttons, lights, switches and dials, even fasteners, to provide pilots with the best possible layout for shooting instrument approaches. Harmon, a multi-engine pilot, worked on panel layouts and insisted that all controls be arranged for one-man operation.

There is a transparent pocket for instrument approach charts; immediately on the right are the radio and navigation equipment controls. In front of the pilots are all of the dials for monitoring the airplane's approach. Between the approach plan and dials are the marker beacon lights, arranged vertically so that they go off in functional order. Atop the flight dials, in easiest position for the pilot to check just after a visual check outside the cockpit, are, from left to right, airspeed, Collins Flight Director Horizon and altimeter. Immediately below the FDH is a course indicator.

Overhead in the center are eight secondary engine instruments combining 25 functions. Above this group, laid out for the individual engines, are grouped emergency controls to feather the propeller, shut off ignition, generator and all firewall cutoffs such as fuel and propeller anti-icing fluid supply. In emergency, the pilot can pull a single lever downward that simultaneously throws these controls to completely secure the proper engine ahead of the titanium firewall. There is a master warning light in front of the pilot to alert him of engine problems. Incidentally, the 620 also has titanium nacelle skins, to contain possible engine fires.

Fuel planning is handily arranged on a complete schematic diagram atop the control pedestal. Fuel switches are func-

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tional, so that transfer is made by moving the switch in the appropriate direction. At top center of the schematic is a totalizer. By pressing buttons adjacent to the indicated tank, pilots can directly read fuel remaining for any or all engines. When boost pump and transfer switches are activated, arrows light up on the schematic to indicate fuel flow direction.

Magneto switches are located on the left side in a row over the pilot's head in a gate that can be key-locked should the pilot want to ensure that no one will start the airplane. To provide maximum comfort while flying, pilots can adjust the height of the control wheel arms.

Electronic equipment compartment is on the left side between the cockpit and the cabin and across the aisle from the buffet. The electronics section is ventilated and hot air dumped overboard, to maintain proper temperatures and prolong equipment life.

One-Piece Wing

The one-piece wing fits into cutouts in the fuselage belly and is attached by four main bolts. Of conventional structure, two-spar construction goes out past the main wheel wells, from there tapers out to form a box. Double skinning is used on top and bottom, the outer skins being aluminum, the inner skin magnesium and a magnesium corrugated section sandwiched between the skins to provide extra rigidity. Similar skinning is used on the stabilizer and vertical fin.

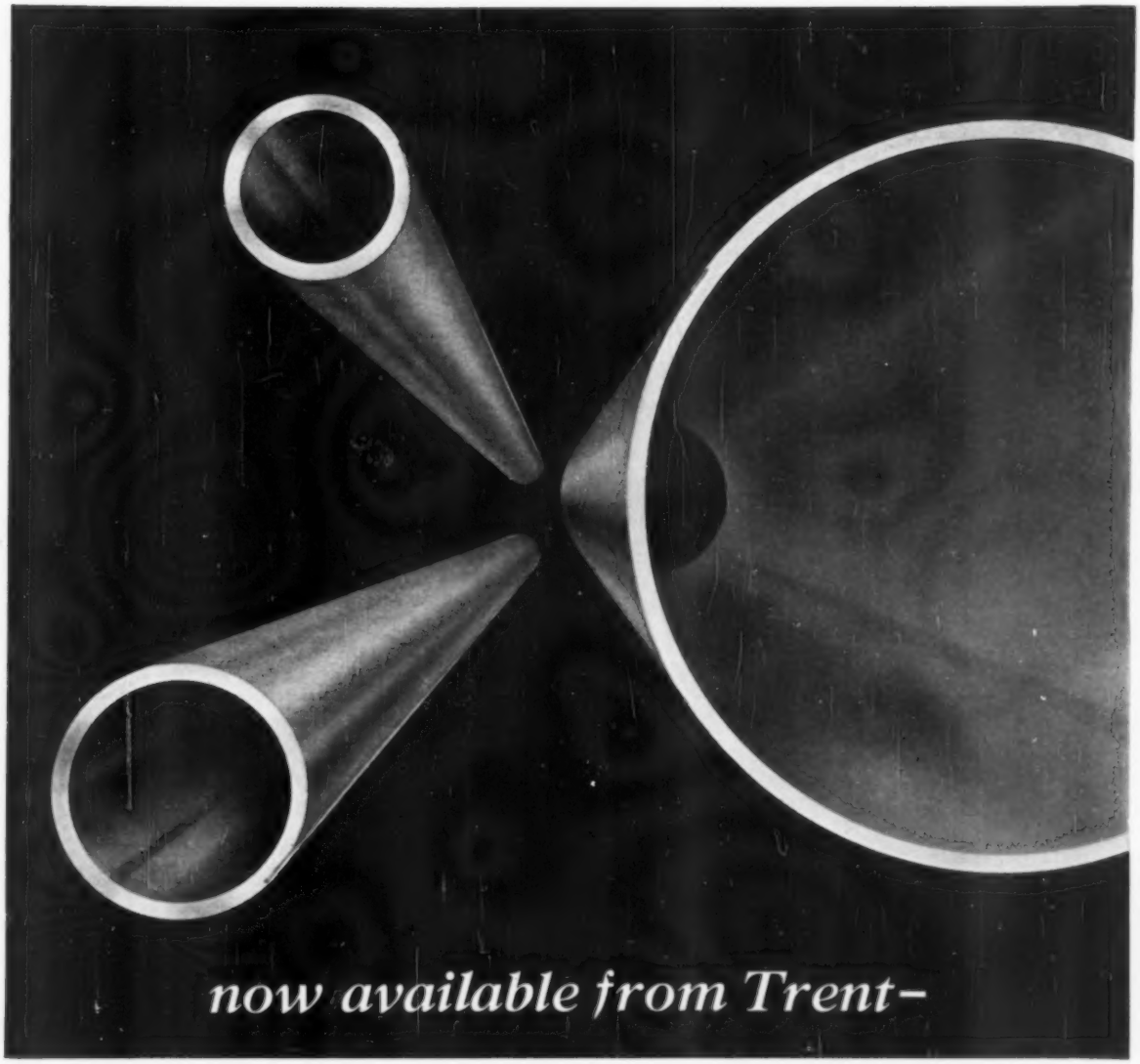
Structural strength of the Model 620 exceeds CAA 4b transport category requirements and is designed to withstand gust loads exceeding 40 fps. The airplane can be flown through frontal activity using normal transport practice, Cessna reports.

An NACA 24-series airfoil section was selected because of excellent stall characteristics and good short-field takeoff and landing features. Slotted lift-type flaps slide back, then can go down 40 deg. maximum.

The Cessna-designed-and-built landing gear has two 3,000-psi. hydraulic, continuous operating, variable-volume-type New York Air Brake pumps. Because of their large capacity, they pull the tricycle landing up in about five seconds. In addition to a hand pump for emergency lowering, there is also a CO_2 actuation system. Harmon said that the 620 is being converted to using nonflammable Skydrol hydraulic fluid.

Landing gear comprises 32x8.8 Goodyear main wheels and 26x6.6 nose wheel with high-pressure Goodyear tires derated to 65-70 psi. from 125 psi. Goodyear single-disk brakes are used. Brakes are power-boosted and have manual over-ride.

Non-skid brakes and power steering are offered as optional equipment.



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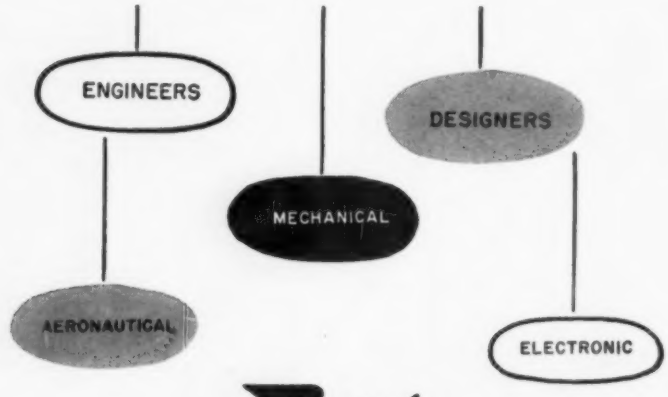

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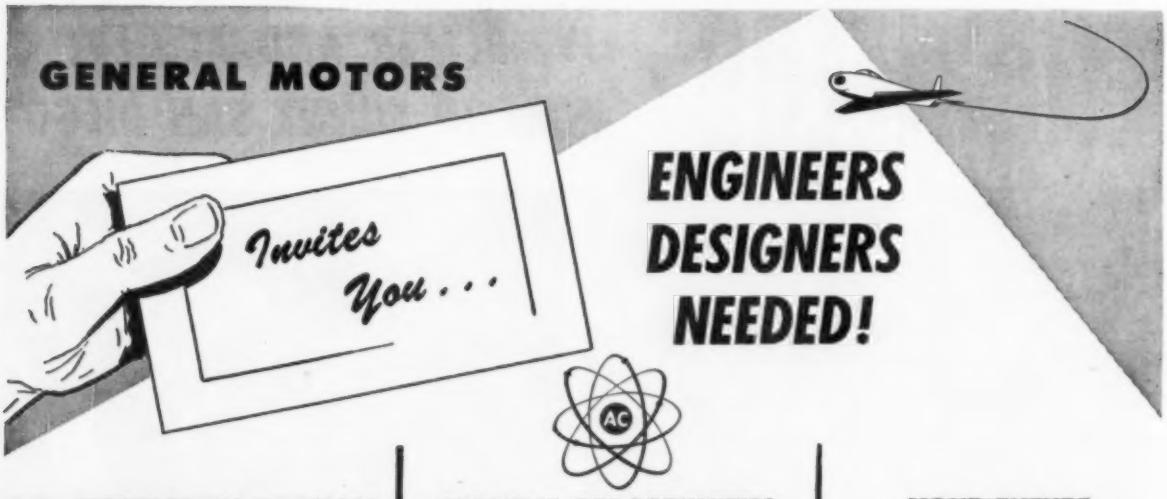

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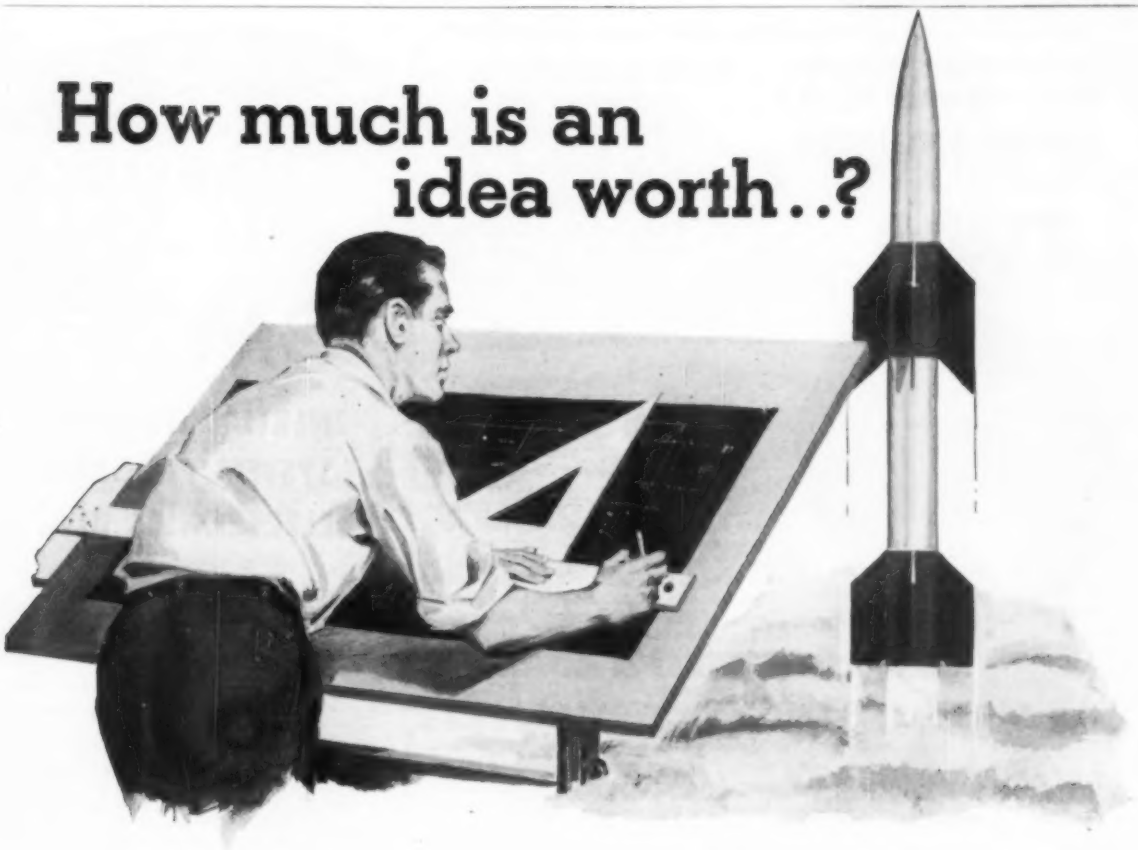

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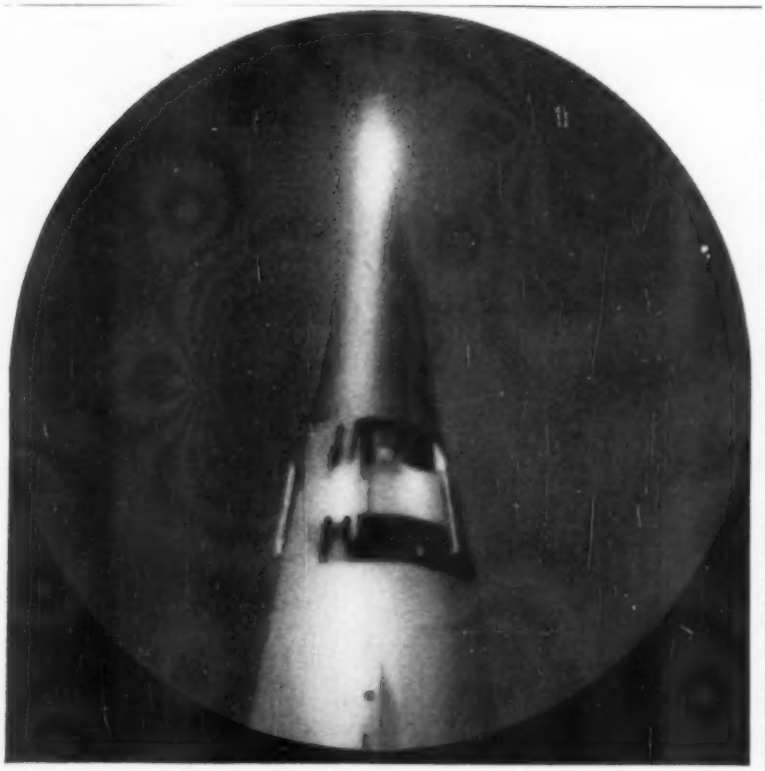

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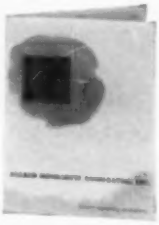

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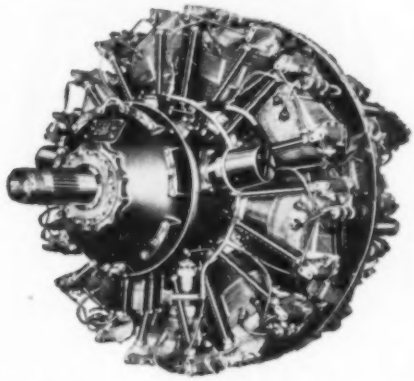

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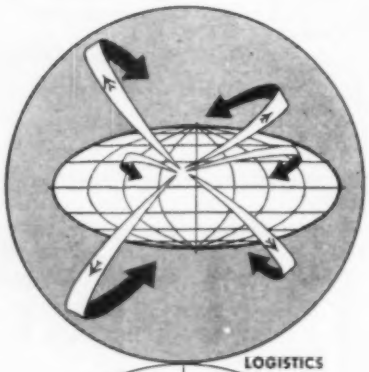

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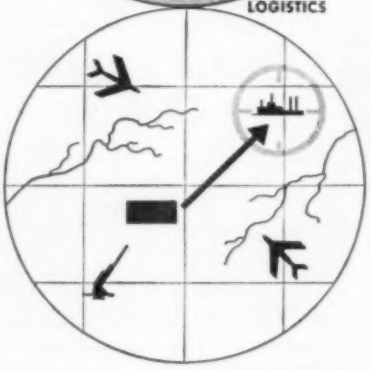

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AUSTENAL LABORATORIES, INC. (MICROCAST DIVISION) 11
Agency—Gaynor, Colman, Prentis & Varley, Inc.
AVCO RESEARCH & ADVANCED DEVELOPMENT, DIV. AVCO MFG. CORP. 99
Agency—Benton & Bowles
AVIATION TRAVEL SERVICE 84
Agency—Richardson Advertising Agency
AVIATION WEEK 92, 93

BEECH AIRCRAFT CORP. 74
Agency—Associated Advertising Agency, Inc.
BELL AIRCRAFT CORP. 102
Agency—Baldwin, Bowers & Strachan Inc.
BRIDGEPORT BRASS COMPANY (ALUMINUM DIV.) 81
Agency—Hazard Advertising Company

CALIDYNE COMPANY 54
Agency—Meissner & Company, Inc.
CHAIN BELT COMPANY, SHAFER BEARING DIV. 10
Agency—Buchen Company
CONAX CORP., EXPLOSIVE PRODUCTS DIV. .....
Agency—Harvey Advertising Agency
CRAIG SYSTEMS INC. 75
Agency—Larcom Randall Adv.

deHAVILLAND AIRCRAFT OF CANADA LTD., THE 56
Agency—Samson Clark & Co., Ltd.
DOUGLAS AIRCRAFT CO., INC. 100
Agency—J. Walter Thompson Co.

EX-CELL-O CORPORATION 71
Agency—Holden-Chapin-Larue, Inc.

FAIRCHILD ENGINE & AIRPLLALNE CORP. ..35, 89
Agency—Gaynor, Colman, Prentis & Varley, Inc.
FLIGHT REFUELING, INC. 76
Agency—Davis, Parsons & Strohmeier, Inc.

GENERAL ELECTRIC COMPANY ..41, 45, 60, 61, 78, 79
Agency—G. M. Basford Company
GENERAL ELECTRIC CO., TUBE DIV. 48
Agency—Maxon, Inc. Adv.
GOODYEAR AIRCRAFT CORP. 3
Agency—Kudner Agency, Inc.

HEXCEL PRODUCTS CO. 86
Agency—Peter Hurst Advertising, Inc.
HUGHES AIRCRAFT CO. (RESEARCH & DEVELOPMENT LABORATORIES) 116
Agency—Foote Cone & Belding
HYDRO-AIRE, INC. 70
Agency—Byron H. Brown & Staff Inc.

INTERNATIONAL NICKEL CO., INC., THE 82
Agency—Marschalk & Pratt Co., Inc.

JET PROPULSION LABORATORY, (DIV. CALIFORNIA INSTITUTE OF TECHNOLOGY) 64
Agency—Frank Barrett Cole Adv.

KEARFOTT COMPANY, INC. 90
Agency—F. M. Freystadt Assoc., Inc.
KELSEY-HAYES WHEEL CO. 36
Agency—Zimmer, Keller & Calvert, Inc.

LAVELLE AIRCRAFT CORP. 5
Agency—The Roland G. E. Ullman Organization
LEACH CORP., INET-PALMER DIV. ..... 3 Cover
Agency—Hixson & Jorgensen, Inc.
LEWIS ENGINEERING COMPANY, THE 95
LIBRASCOPE, INCORPORATED 18
Agency—Western Advertising Agency, Inc.
LINK AVIATION, INC. 24
Agency—Gaynor, Colman, Prentis & Varley, Inc.
LOCKHEED AIRCRAFT CORP. 89
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Agency—Griffin & Rowland
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Agency—Heintz & Co., Inc.
MINNEAPOLIS-HONEYWELL REGULATOR CO. (AERONAUTICAL DIVISION) 50, 51
Agency—Foote, Cone & Belding

PRATT & WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP. 83
Agency—Lennen & Newell, Inc.

REACTION MOTORS, INC. 12
Agency—J. Wheelock Associates
RESEARCH WELDING & ENGINEERING CO., INC. 74
Agency—Dan Ebberts Advertising
ROBINSON AVIATION INC., AIRBORNE DIV. 15
Agency—Platt, Dyson & O'Donnell, Inc.
ROBINSON CO., RALPH C. 74
Agency—Chapin-Damm Adv.
ROHR AIRCRAFT CORP. 58
Agency—Barnes Chase Company
ROYLYN INC. 59
RYAN AERONAUTICAL COMPANY 13
Agency—Batten, Barton, Durstine & Osborn, Inc.

SERVOMECHANISMS, INC. ..... 4th Cover
Agency—Sanger-Funnell, Inc.
STEINEN MFG. CO. 88
Agency—Reid Decker & Stock, Inc.
STEWART WARNER CORP. (ELECTRIC DIV.) 72
Agency—Buchen Company
STILLMAN RUBBER CO. 54
Agency—Lynn-Western, Inc.
STROUKOFF AIRCRAFT CORP. 65
Agency—J. Wheelock & Associate
SUNDSTRAND MACHINE & TOOL CO. ..... 2nd Cover
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TELE-DYNAMICS INC. (RAYMOND ROSEN CORP.) 68
Agency—Al Paul Lefton Co., Inc.
TEMCO AIRCRAFT CORP. 17
Agency—McCann-Erickson, Inc.
THERM-ELECTRIC METERS CO., INC. 88
Agency—Taylor M. Ward, Inc.
TITANIUM METALS CORP. OF AMERICA 7
Agency—W. L. Towne Advertising
TRANS-SONICS, INC. 77
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Agency—Van der Boom, Hunt, McNaughton, Inc.

VERTOL AIRCRAFT CORPORATION 14
Agency—Gaynor, Coleman, Prentis & Varley, Inc.
VICKERS-ARMSTRONG LTD. 20
Agency—McCann-Erickson, Inc.
VICKERS, INC., DIV. OF SPERRY RAND CORP. 94
Agency—Witte & Burden Adv.

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WHITTAKER GYRO, INC., DIV. OF TELECOMPUTING CORP. 117
Agency—Mogge-Privett, Inc.
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LETTERS

Admiral Ramsey

I wish to say a few words regarding the contents of the Washington Roundup story (AW Aug. 27, p. 25) about Admiral D. C. Ramsey, president of our Aircraft Industries Assn. As one who has known and worked closely with Admiral "Duke" Ramsey for many years as an AIA board member and otherwise, I am deeply disturbed over the serious inaccuracy of it.

Based on personal knowledge, I know that Admiral Ramsey enjoys the highest confidence and respect of the aircraft industry and government leaders alike. He has performed as our industry association president and manager with the same keen judgment, zeal, and all-around superior ability that marked his brilliant, patriotic service to our country as a naval officer. The fact that it was decided, at his own suggestion, to take steps toward finding a successor in advance of the time his term of office expires, could hardly justify speculating that the reason was dissatisfaction.

I am extremely sorry that the completely unfounded injustice was done.

T. Claude Ryan
President
Ryan Aeronautical Co.
San Diego, Calif.

Along with thousands of friends, associates and admirers of Admiral DeWitt C. Ramsey, I was puzzled and distressed by the baseless and unwarranted statement in the Aug. 27 issue of Aviation Week that "deep-seated dissatisfaction with the ineffectiveness of his regime in dealing with key industry issues has cast the die in favor of a successor" as president of the Aircraft Industries Assn.

I know of no one on the Board of Governors of our organization who has ever questioned Admiral Ramsey's ability, integrity or the high esteem in which he is held by the responsible leaders in all branches of our armed services and our industry. His record as president of the AIA has been brilliant, constructive and most certainly effective.

In the light of Admiral Ramsey's numerous achievements and long and honorable services, both to his country and to the AIA, such vague innuendoes and aspersions as your Washington Roundup paragraph exudes suggests the possibility that your publication was deliberately supplied with incomplete and distorted information.

Donald W. Douglas
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

Since I am a long time and constant reader of Aviation Week I noted your statement on page 25 of the Aug. 27 issue concerning Admiral DeWitt C. Ramsey's tenure and character of service as president of the Aircraft Industries Assn. While I am sure you made these statements based on information which you at that time believed to be reliable, I can assure you that they do not coincide with the facts.

As a member of the Board of Governors of the Aircraft Industries Assn. for the past eight years, I have attended all meetings of the Board and have been in close contact with the work of the association since Admiral Ramsey became president. I know I express the unanimous view of our Board when I say that we all regard him highly and we feel he has been very effective as our president.

I believe I have known all the presidents of the Aircraft Industries Assn. for the past 25 years, and I can say without qualification that no one of them was more devoted to the interests of American aviation, and none was more thorough and conscientious in the performance of his duties than Admiral Ramsey. Ira C. Eaker
Lt. Gen. USAF (Ret.)
Hughes Tool Co.
Aircraft Division
Culver City, Calif.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

(Aviation Week is pleased to present the views of three distinguished leaders of the aircraft industry and members of the Aircraft Industries Association Board of Governors. On rechecking the facts of the Aug. 27 report referred to above, we find that Admiral Ramsey's contract as president of AIA runs until July 1958, instead of this November. However, his replacement has been planned for late this fall or early next year rather than the expiration date of his contract.—Ed.

Jet Starter

The picture on p. 28 of your August 20 issue shows a highly important development in the starting of jet engines. We at Standard Oil (Indiana) are proud of the fact that the new propellant was developed through our research, and we appreciate the credit line given us in the placard on the nose of the bomber. Unfortunately, the placard can not be read in the reduced version of the picture.

D. E. Kennedy
Technical Associate
Standard Oil Co. (Indiana)
Whiting Research Laboratory
Whiting, Ind.

Eyewitnesses

During the investigation of the Grand Canyon accident it was reported that the Civil Aeronautics Board repeatedly tried to shake the story of one of the eyewitnesses ("Eyewitnesses Describe TWA-UAL Crash", AW Aug. 13, p. 38).

I am of the opinion that testimony of both eyewitnesses could easily have been demolished by any observant pilot.

After several years of observing DC-6, DC-7, and Constellation aircraft at varying distances and against different backgrounds, I have come to the conclusion that the maximum distance that one of the above type aircraft can be seen by the unaided eye of 20/20 vision, in conditions of excellent visibility and against a perfect background (white clouds) is approximately 30 miles. At this distance they will, of course, appear as mere specks.

Since one of the witnesses was about 70 mi. from the scene of the accident, and the other 85 mi. (and there were no reports of binoculars being used) I would say that both accounts were highly exaggerated, to say the least. J. A. Gray
Hayward, Calif.

X-Ray Use

The article in the Aug. 13 issue (p. 76) of your publication which covers the use of X-rays in aircraft maintenance, was very informative but X-rays are not the panacea for inspection problems which this article seems to imply.

You mention, frequently, the use of X-rays for the detection of cracks in structural and like members. However, you fail to emphasize the importance of the location of the source of X-rays relative to the object being examined. Unless this positioning is absolutely perfect, a cracked member can be passed out as a sound member.

This exact positioning in most cases is extremely difficult if not virtually impossible to do, particularly when attempting to X-ray for a "tight" crack in an internal part in, for example, the wing of a large aircraft. This difficulty applies even when it is known where a crack, if present, may be situated.

I trust you will clarify this matter so as to avoid the embarrassing situations which arise when articles such as yours are quoted to laboratory personnel who say "such a thing can not be done."

J. J. Waller
Chief Materials and Process Engineer
Canadair Ltd.
Montreal, Canada

Engineer Shortage

I've been reading your articles on the "shortage of scientists and engineers," and I'd like to give you my opinion of why the shortage.

First of all, many high schools don't have any aviation courses. Without courses how can anyone know anything about aeronautical engineering or what it's like?

Second, colleges don't publicize any courses in aviation they offer. I just learned about one in Chicago after I graduated from high school. (I'm starting this school in September.)

If colleges and high schools could offer better courses and tell the students how badly the country needs engineers and of the future of an engineer, I'm almost sure our country's problem would be solved.

Joseph Sojka
Cicero, Illinois

400 cycle power

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Accurate device *output* demands accurate power *input*, and in 400-cycle equipment—vital in today's aircraft and missiles—accuracy is everything. For the *precise* input power needed in designing, manufacturing and checking out of modern avionic systems, it's a growing habit to buy LEACH (INET-Palmer) 400-Cycle *Precise* Power...complete packages, ready to "plug-in."

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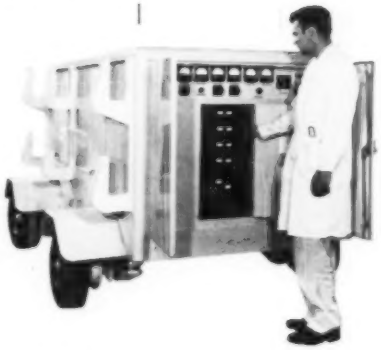

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1-phase: 3 to 85 KVA @ .8 P.F.

Output Voltage. . . 115/200 or 120/208, 3-phase, 4-wire
115 or 120, single phase

Input Voltage.....440 volts, 60 cps, 3-phase (220 or 220/440 optional)

Overload Rating.....125% for 3 minutes

Regulation:
Frequency. . . 400 cps ±0 cps with 60 ± cps input
Voltage..... ±1% (±½% optional)

Recovery Time.....to 20 KVA — .150 sec.
20 to 50 KVA — .200 sec.
62.5 to 125 KVA — .250 sec.

Voltage Dip or Overshoot.....less than ¼%

Voltage Modulation.....less than ¼%

Frequency Modulation.....less than ¼%

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Wave Form.....3% rms total harmonic content (2% optional)

Basic Design.....rotating field

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